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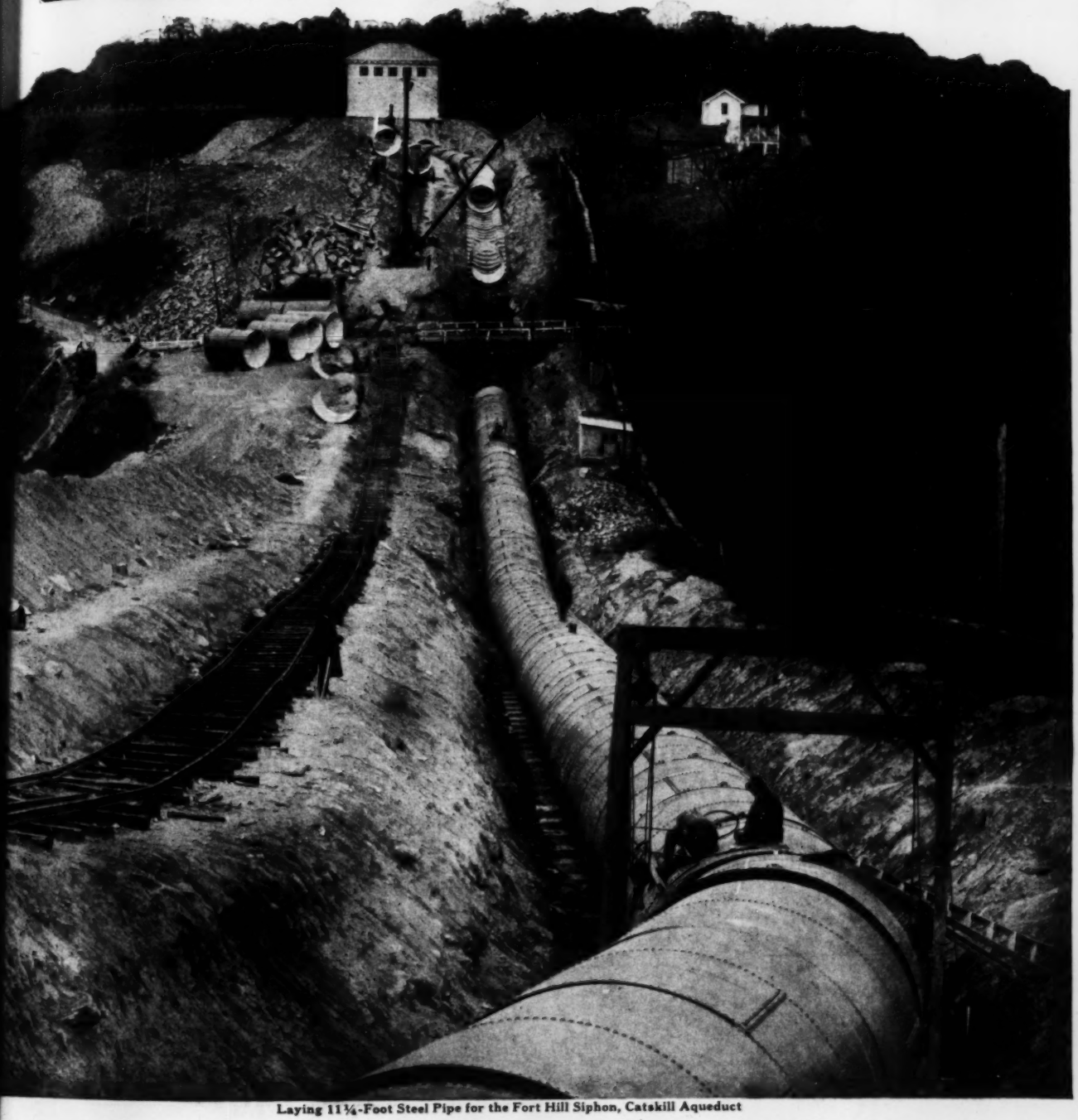
May 17, 1923

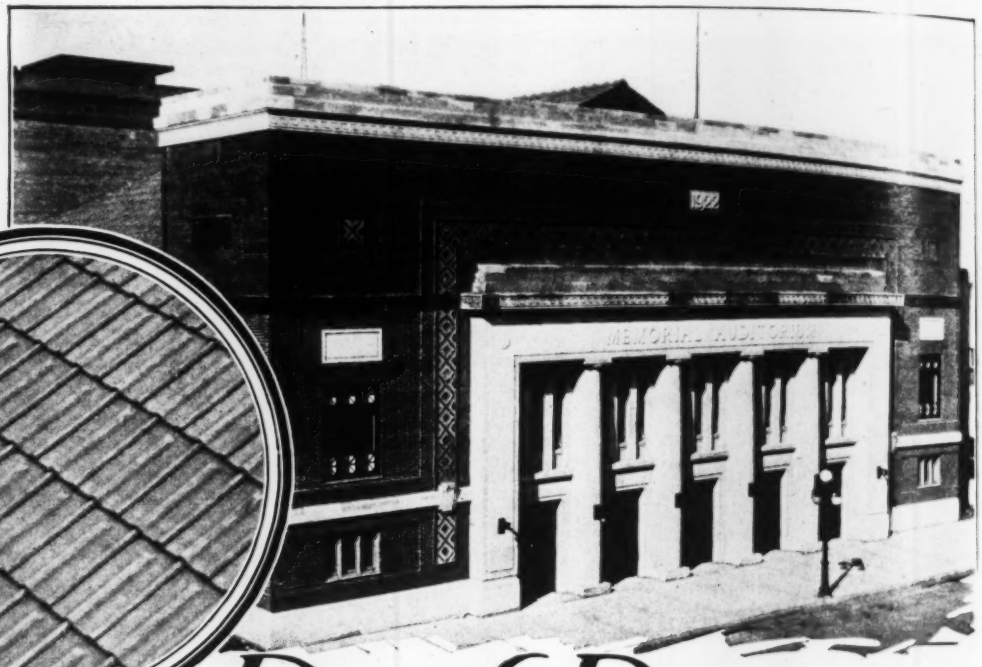
Engineering News-Record



Laying 11¼-Foot Steel Pipe for the Fort Hill Siphon, Catskill Aqueduct

FOR WATER-WORKS ENGINEERS—**Building Additional Catskill Aqueduct Siphons: Overhauling Outgrown Arkansas Water-Works: Detroit's 320-M. G. D. Filtration Plant: Payment of Water for Fire Protection: Aeration Experiments for Removing Carbonic Acid: Omaha Filtration Plant—And six pages of *"Job and Office"* hints, mostly for the operator**

so staff reports of two conventions: American Association of Engineers — United States Chamber of Commerce



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 90 — NEW YORK, MAY 17, 1923 — Number 20

This Water-Works Issue

IN RECOGNITION of the promising convention of the American Water-Works Association at Detroit next week, much of the space of this issue is devoted to water-works and related topics. In range of subjects, interest, and value, particularly interest and value to the water-works operator, we feel that this water-works issue surpasses any that has been brought out by this journal or either of its predecessors. A new feature is afforded by devoting nearly all of the current Job and Office Section to the water-works field.

Locomotive Water Supplies

QUESTIONS of water supply have been considered hitherto mainly from the point of view of domestic and manufacturing uses or consumption, but increasing attention is being given to railway water supply, both for drinking purposes and for the locomotives. On the part of railroad officials there is a growing appreciation of the fact that water service means something more than providing water of some sort at convenient intervals for filling the tender tanks. It involves supplying water of good quality as well as in adequate quantity and at the required places. Furthermore, it has an important relation to the operating efficiency of the railway. As a result of wider appreciation of these economic aspects there is an increasing tendency to establish water service departments having control of the entire question of water supply on the railway, instead of having this service divided between the engineering, mechanical and bridge and building departments, as has been general practice in the past.

Backfilling Reforms

BACKFILLING is the one element in installing underground services in paved streets which is most commonly poorly done. Pavement failures have always been numerous because of settlement over trenches loosely filled and quickly covered, but now with increasing truck traffic and far heavier loads these failures are becoming alarming. So bad has the situation become in some large cities that drastic correction is contemplated. In Philadelphia the Bureau of Water engineers predict that it may be necessary to retain 5 per cent of the contract price for 12 months if present experience with sunken trench fills shall continue. The penalty it will be noted is put on the contractor. As specifications for trenching are commonly written it may be questioned whether the contractor can be justly held responsible for the stability of backfill. Disquisition on abstract justice will, however, gain the contractor nothing. He has to correct the fault or submit to the penalty, if the engineer chooses to make him. Almost any trench can be backfilled so that there will be no considerable settlement. Every experienced contractor knows how. He knows too that it will cost more money than the city engineer is in the habit of thinking ought to be paid for backfilling. To meet competition and get the contract he takes the chance that everyday practice will pass the inspector and that the pavement will bridge over any defects for a long enough time to furnish the backfilling an alibi. Altogether the situation is one for which the city engineer is as largely responsible as is the contractor. For better practice both must regard backfilling as an essential unit of the structure and, therefore, as something which has to be paid for at a cost proportionate to its quality.

Courageous Pioneering

PIONEERING on a large scale and in the face of considerable opposition is now going on at the Port Reading Creosoting Plant in New Jersey. The superintendent of the plant, basing his action on the results of a test of some pine ties which are still in good condition after eleven years of service although impregnated with only three pounds of creosote to the cubic foot, has started treating ties with a mixture of thirty per cent creosote and seventy per cent fuel oil. This mixture gives approximately the same amount of creosote per cubic foot in the treated ties as is in the test ties and in addition there will be a few pounds of fuel oil. No other plants in the country, except those using zinc chloride in combination with creosote, have gone so far in an attempt to conserve the limited supply of creosote. The step is opposed by many members of the American Wood Preservers Association in spite of the demonstration of the test ties still in service which they saw on their inspection trip last week. Unfortunately it will be years before the results of this vast experiment will be known. But if it is as successful as the ties in the test section seem to indicate this action will have been a notable step in the direction of economical timber preservation.

A Job for the Engineer

ANYTHING that can be done to reduce the killings and maimings due to the motor vehicle is worth while. The horror at the multiplicity of such accidents is growing and the demands for a cure become more and more insistent. The danger now is that too much reliance will be placed in driver control. We find, for instance, that the country's police chiefs, assembled in New York City, are "agreed that the remedy is a more careful system in licensing drivers, a system that will exclude the careless and the inefficient from the operation of cars of any kind." Such control is most necessary—but it will save only a part, and a small part, of the accidents. Most motor accidents are due either to a state of mind which inheres in the driving of an automobile or to conditions beyond the control of the driver. More elaborate examination of drivers will do little to change this state of mind. On the other hand overcrowded streets, unnecessary parking, lax crossing regulation, inadequate and unsystematized traffic lanes, are the main sources of motor accidents. To cure these evils is a job for the engineer.

High Spots in a Business Meeting

MEETINGS such as that of the Chamber of Commerce of the United States are worth while not so much for the actual production of constructive thought or action at the meeting itself as for the dissemination of ideas throughout the country. At New York last week four or five thousand of the influential business men of this country met in sober consideration of national business problems. They listened to papers and reports of their committees and at the end they adopted without objection some rather colorless resolutions provided for them by a committee. On the face of it this was not worth the cost. But the real benefit is to come when all of these men go home there to spread, both formally and informally, the thoughts they absorbed in the three days' sessions.

By intent the meeting emphasized the problem of transportation. The restriction of proper business expansion by the confused treatment of the railroads, and the lack of co-operation between rails, waterways and highways cries out for correction. To that end the Chamber has initiated the so-called Transportation Conference to formulate some program for reform. That conference has only just started and could not therefore report at the meeting but the outline of what it proposes to do, which was reported, indicates an investigation of unprecedented scope and authority. Merely to inform the members of the extent of the problem and the prospective information to be obtained was distinctly worth while, for it should serve to restrain those who see in the transportation problem only those difficulties which affect them alone and who are too prone to rush into proposed solutions which would complicate more than solve.

On the other major subject of the meeting, immigration, the results of the meeting are not so impressive. The Chamber's committee—and the resolutions' committee—advocate some letting down of the immigration bars, not to the extent which those seeking cheap labor would wish but sufficient to get what they believe would be a better selection of new blood. The difficulty is that they offer no constructive recommendations as to how this selection is to be made and there is still much vagueness as to just what quality in an immigrant makes him desirable. The danger of selection by nationality was pointed out by one of the invited speakers and another, who holds the strategic position of chairman of the immigration committee of the House of Representatives, while admitting that we need "more producers and fewer peddlers" stated unequivocally that restrictions are to be tightened rather than loosened. The net impression from the meeting is that there is considerably more imagination than fact in most of the ideas regarding the immigrant, but that the average business man is afraid of too free an immigration policy.

One further fact was hammered home to the thousands who heard Secretary Hoover's address. That is the individual's responsibility for the business stability of the next few months. Mr. Hoover made clear the changed production and consumption status of the United States since the war and said a needed word against extreme caution or panicky fear for the future, but at the same time none of his hearers—all of whom have control of the reins of some business—could go away and think that he could proceed happily on any unrestricted path of price elevation or overproduction and hope to gain while his fellows exercised more sane judgment. To have done this was an excellent reason for the existence of a Secretary of Commerce.

Finally, an engineer commenting on this business mans' meeting must perforce note the almost complete absence of his professional fellows. Enough has been said to show that the topics discussed were not only of interest to engineers but such as would have been illuminated by their discussion. The engineer, however, continues to consider himself aloof from business or possibly the business man continues to consider the engineer only an employee or professional adviser. That both business man and engineer would benefit by closer co-operation goes without saying. To bring about that co-operation continues to be one of the greatest problems for the engineering profession.

Water Waste in Chicago

WATER waste continues merrily on its way in Chicago. The latest annual report of Alex Murdock, city engineer, states that the peak in the daily pumpage is more than a billion gallons or at a rate of 367 gal. per capita. The really significant fact however, is that Chicago has so little pressure—18 lb. is the average normal in the summer. Unless some method is devised to check waste Mr. Murdock baldly and prophetically states that there are no limits to the needs of additional stations, mains and pumps.

What is Chicago going to do about water waste? How? When? Engineers and thinking citizens who have looked closely into the situation, as did the Chicago Bureau of Public Efficiency six years ago and the Western Society of Engineers at its annual mid-winter convocation in January are certain there must be an end point soon. The estimable report of the bureau was brought up to date and the latest phases of the situation were put before the society but not much headway seems possible, for the solution requires general education of the citizens to push the mayor and council. However, two vulnerable points of attack which politicians and the general public can understand were made available. Mr. Murdock's discussion of the low pressure discloses that 75 per cent of the people do not get adequate service. L. R. Howson, in a most exhaustive paper, replete with figures, charts, diagrams and comparisons, showed diagrammatically this drop-down curve of pressures after leaving the pumping stations. The second point of layman vulnerability is the fact brought out by Maj. Myron B. Reynolds, engineer of the water department, to the effect that the water business is no longer a money-making proposition. It is beginning to run behind. No more can the budget makers look to the water consumer to make up deficits in the corporate fund. Last year for the first time the plotted line of expenditure hopped over the line of receipts by a million or so.

The newly elected mayor of Chicago, if he and his council are wise, will be able to make a "showing" quicker in the water department than in any other municipal activity. No place else can he make such a saving and at the same time increase service to such a large majority of his constituency. If within a reasonable time he shows no sign of attacking the problem, engineers should lose no time in making their influence felt in backing up the judgment of the department's staff, which for years has advocated waste elimination.

A Turning Point

AN EPOCH is marked in the life of the American Association of Engineers by the Norfolk convention of last week. The organization has now definitely passed from promise and hope to productive achievement. Its committee reports show work of real and extensive value. Certain of the results outmatch anything that has been brought forward by other engineering organizations in the field of professional activities. The report of the convention on another page of this issue briefly sets forth the record of production.

Why has this work been accomplished? The men in the American Association are no different from those in other societies. Perhaps there is a larger proportion of younger men, and also more of the men whose temperaments lead them to seek results rather than dignity or distinction. But otherwise they are much the same kind of men as are found in the technical societies. The distinctive thing about the association, we are inclined to believe, is its atmosphere of courage. No fear prevails there in the matter of a frank attack on professional evils—unfair competition, abuse of position to obtain personal advantage, unsatisfactory relations between engineers or between public and engineers, political activities, or such plainer evils as incompetence. That quality of courage can carry the association far. It provides an atmosphere in which many engineers find their best working conditions, in which they can think and act without too many hampering fetters, joining their strength with that of other men of the same temper.

With this great asset of courage and with the record of production it now has made, the association is at the entrance to a worthwhile career. Its achievements so far are fruitful beginnings of broader and more influential activities. The opportunity is before it to become a lasting force in the field of professional engineering—*if it survives.*

If it survives, we say in all earnestness. For at the very moment when it demonstrated its ability to produce, the association also gave signs of being stricken with serious, perhaps fatal, disease. Selfishness, misunderstanding and quarrelsomeness are at work. Perhaps they are in part an outgrowth of the very quality of courage which is the association's chief virtue. However, they all but paralyzed the activities of the convention and were prevented only by a small margin from splitting the organization in two.

Disintegration threatens today almost as much as at the convention. The danger is less threatening only because the full extent of the evil is now apparent and all the forward-looking elements of the association understand the challenge to their efforts for progress. They are united—or will be if they realize their opportunity. The issue is disintegration into non-coherent and worthless fragments. It can be met, we feel confident, and progress assured, if the association's supporters will rally under the banner of harmonious purpose for the advancement of the profession, devoid of narrow-visioned planning for group advantage.

Out of such union of purpose, we believe, there will develop a truer understanding of the association's essential problem. For there is a real problem, and it is a difficult one. Because it is misunderstood, and seen from one-sided viewpoints and interpreted narrowly—rather than because of sinister purposes—the internal strife and bickering have come about. The problem lies in the fact that much of the work and the inspiration of the organization centers in its national activities, while the chapters are the source of nearly all its life blood. It will be solved only when, while maintaining the national functioning unimpaired, and indeed extending it, the chapters are so developed as to acquire lasting vigor and independent productiveness. The solution is to be attained not by decentralization, not by dispersing national authority and national initiative to a hundred chapters, but by fully awakening the local initiative and applying it to the local problems and opportunities. That is and will remain a local problem.

Two years ago, when the association first entered upon the experiment of decentralization into local groups held together by rather loose federation, we were apprehensive of the outcome. "Tradition would lead us to be fearful of the plan," we said. "If the chapters throughout the country grasp and handle the local problems to the credit of the profession, and at the same time continue loyal adherence to the national body, the decentralized policy will be adjudged successful." Today we have the answer to these questioning doubts. The policy has not proved successful. The attack on local problems has, with some exceptions, been neither energetic nor successful, and the aim to support national work has been submerged by local aims.

Local activity can be made a success—that has been demonstrated in the American Association of Engineers itself; and inasmuch as some of the local sections of other societies have managed to be no more than dignified and respectable failures, the association need not be discouraged if only a few of its chapters have succeeded in developing vital work in their own communities. But more than any of the technical societies, the association, because of its nature and objectives, must make its chapters strong, for it is there that the interest and the coherence of the membership are born. And the chapters must make the national work strong, and must support it with faith, enthusiasm and initiative.

Finances, of course, are an always present problem, just as is that of chapter activities. And so also is it a problem how to satisfy those who feel discontented because they have not received a money return through the association's activities to outbalance their membership dues. Not all of the membership realizes as clearly as it should that the profession jointly must work out the difficulties which beset all of its several parts and that no single small group can look for much assistance in its individual narrow problems elsewhere than in a general lifting up of all parts of the profession.

But at the present turning point in the association's existence, these matters of detail may be left to one side. All members and all groups must fix their view on the purposes and ideals on which the association's future will be built. It is possible that they may have been forgotten, and may need to be recalled. In the end, each single member of the association must carry within himself a true appreciation of the real justification of his membership, namely, the wish to join in a large-scale co-operative movement for the solution of the professional problems confronting the engineering profession itself and the community as a whole, for the betterment of community life. and for raising the profession by increasing its usefulness to the world. Through such an appreciation the association can avoid ruin and go forward in safety and success. It is now at the turning point of its career.

Detroit 320-M.G.D. Filtration Plant Is World's Largest

Eighty 4-M.G.D. Units Treat Detroit River Water at the High Rate of 160 M.G.D. per Acre—Steel Roofs Over Filters and Coagulant Basins Give Uniform Appearance—Whole Plant on Piles

By Theodore A. Leisen
Consulting Engineer, Department of Water Supply, Detroit, Mich.

DETROIT'S new water purification works will be the largest single rapid sand filtration plant in the world. The plans in their entirety provide for a plant of from 320 to 360 m.g.d., with facilities for meeting peak loads of short duration up to a 400-m.g.d. rate. No provision has been made for future extensions to the filter because, when the average daily consumption approximates 250 to 300 m.g.d., the limits of capacity of all equipment and structures at this location, including the intake tunnel and the pumping engines as well as the filter plant, will have been reached, and any further development on the present site would be injudicious if not impossible. Some of the more novel features of the plant include higher rates of filtration than usual, revolving screens for ice removal, steel roofs over filters and coagulant basins, triangular spacing of columns in the filtered-water basin and rapid mixing at high velocities.

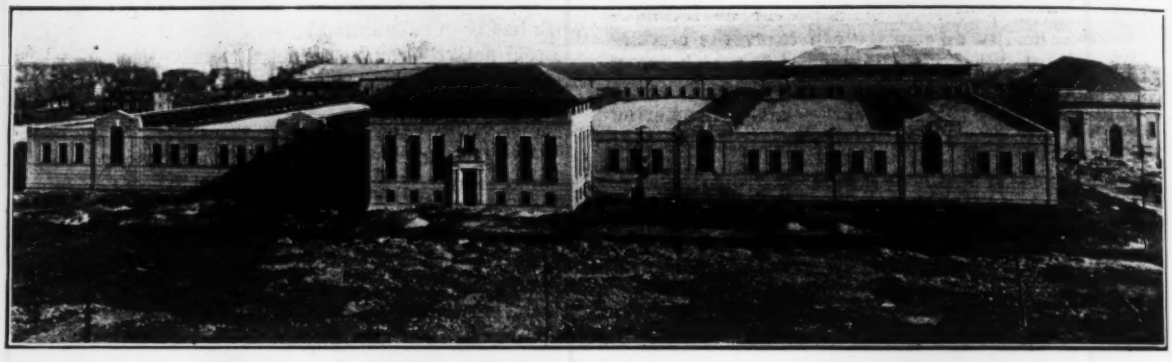


FIG. 1—GENERAL VIEW LARGEST FILTRATION PLANT IN THE WORLD—320 M.G.D. CAPACITY

Administration building in front houses two circular wash-water tanks. Filters are housed under one roof which is supported on steel trusses. Effective sand area is the high ratio of 67 per cent of total area covered by the filters.

As a prelude to a description of the filtration plant, a brief general description of the water-works as well as some allusion to the developments leading up to the adoption of plans for a filter would seem desirable. Prior to 1874 the pumping station and intake were located at the foot of Orleans St. about three miles farther down the river than the site of the present station. The rapidly increasing pollution of the river made water from the Orleans St. intake unsafe and in 1873, in an effort to get beyond the contaminated zone, the property on East Jefferson Ave. was acquired and construction started on a new pumping station, a small settling basin and an intake pipe. This intake pipe and two subsequent ones extended but a short distance into the river. With the increasing concentration of urban population upstream, within a comparatively few years the supply again began to exhibit evidence of excessive pollution, virtually a repetition of the earlier experience at the Orleans St. site. To combat this growing menace and to provide a larger supply a new intake crib and connecting tunnel were built in 1904, the crib located farther upstream and sufficiently distant from the shore to avoid normal pollution-laden currents.

Since that date the water supply for the city of Detroit has been taken from the upper end of the Detroit River, close to the point where Lake St. Clair flows into it, the intake crib being located near the head of Belle Isle and opposite the easterly section of the city at a distance of 3,200 ft. southeastward from the shore line at the pumping station grounds, locally known as Water-Works Park. The intake site was selected after a careful survey had demonstrated it to be the point most remote from and least likely to be affected by the polluted shore currents or incidental contamination from the main ship channel. Time has demonstrated the soundness of the judgment of the engineer who made the selection. A brick tunnel 10 ft. in diameter extends from the intake to the shore shaft whence the water passes through a 10-ft. conduit and several smaller conduits, either into the small settling basin or directly to the suction wells of the pumping stations.

In the effort to secure a pure source of water supply through the medium of shifting locations of the intakes, the ultimate available goal had been attained in the present intake, as there is no evidence extant to warrant the belief that a further extension of the tunnel towards Lake St. Clair would be productive of better results. As a natural sequence, some method of treating the water appealed to reason as the logical solution for safeguarding the supply. In 1913 calcium hypochlorite was resorted to as a sterilizing medium for ameliorating a typhoidal condition which had been gradually exceeding a normal stage. Liquid chlorine was adopted in 1914 and has been used continuously to the present time. That the treatment was necessary is evidenced by the fact that for eight years prior to 1914 the death rate from typhoid fever averaged 22 per 100,000 of population, while for the eight years since then the average typhoid death rate was only 11, and during the past two years was but 5 per 100,000 population.

The foregoing statements outline the evolutionary efforts taken to provide a better water supply and mark the steps which pointed inevitably, if undesignedly, towards filtration. Official interest in the question of filtration was finally enlisted and authority granted in 1917 to construct a small experimental plant, the chief object of which was to prove conclusively the correctness or falsity of the hypothesis previously advanced that Detroit River water could be treated at a rate considerably in excess of what heretofore had been deemed feasible or had been in general use. The experimental plant was completed and put in service the latter part of 1917. Several years' operation demonstrated that the water could be filtered with efficient results up to 200 m.g.d. per acre.

The operation of the experimental filter and the free distribution of its output, with the attendant publicity derived therefrom, in combination with a growing distaste for chlorine flavor, were potent factors in moulding public opinion in favor of filtration. In August, 1920, when the citizens of Detroit voted on the question of issuing bonds to the extent of $12,000,000 one-half of which was expressly designed for the filtration work, the verdict was overwhelmingly in favor of the bonds, and filtered water for Detroit became assured.

Final Filter Plans—A general plan for the proposed filtration plant for Detroit was prepared by the writer in 1916-17, founded on a careful study of existing works in their relation to the proposed plant. During the writer's absence for a period of two years in the army, certain other plans were prepared and a report submitted covering a complete filtration plant. Upon returning to the problem in 1919 the original plans prepared in 1916-17 were investigated and carefully compared with the plans subsequently submitted, from the viewpoints of both construction and operation. The

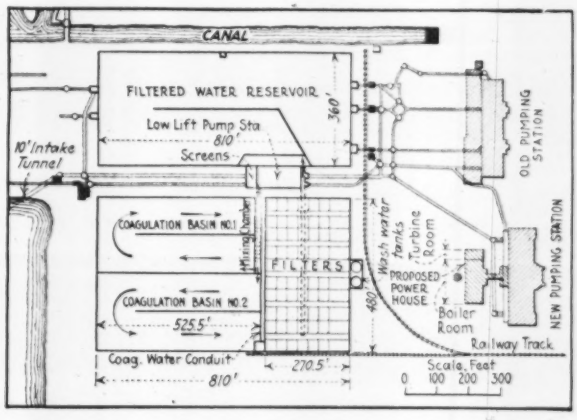


FIG. 2—LAYOUT OF DETROIT FILTRATION PLANT

conclusion was reached that these original plans provided for a more compact, more economical and more workable plant than was possible by any of the other plans which had been prepared meanwhile. In consequence, the original plans have been adhered to in practically every detail except where equipment previously ordered necessitated a change. (See *Engineering News-Record*, June 17, 1920, p. 1194, for general description of the plant before the details were worked out.)

The general design of what may be termed the complete filtration plant is divided into three separate structures: (1) The low-lift pumping station; (2) Coagulation basins, filter-beds and wash-water tanks, all combined under one roof; (3) Filtered-water reservoir. The complete plant occupies a rectangular space 810x937 ft. or slightly over 17 acres. The filters and

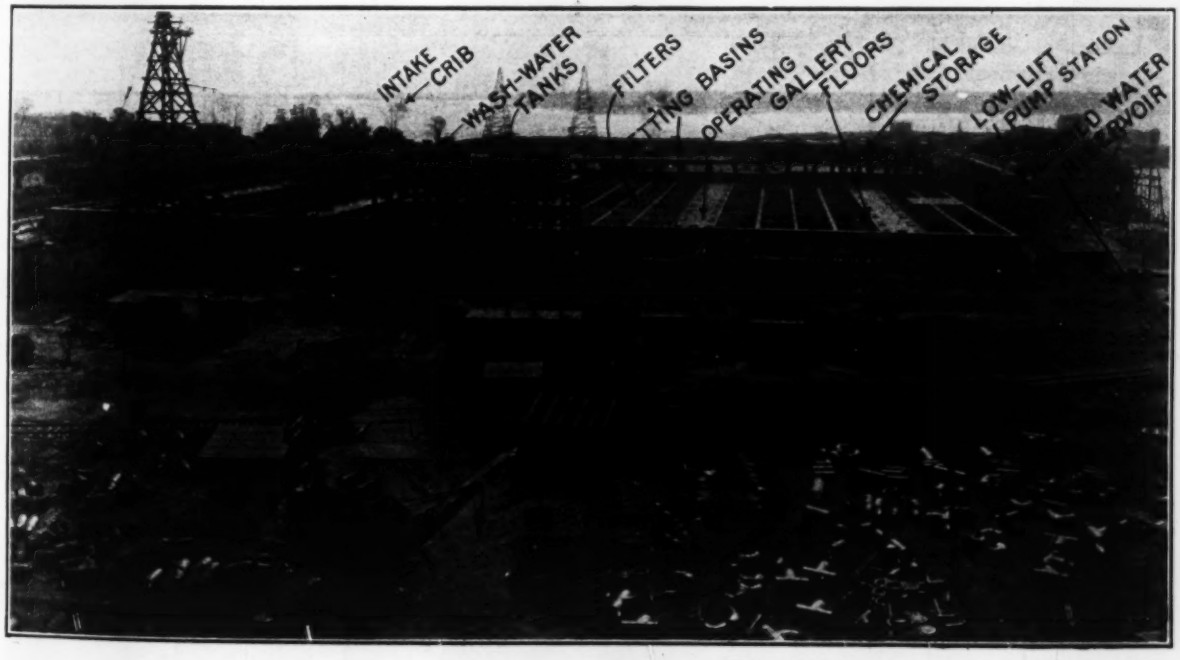


FIG. 3—DETROIT FILTRATION PLANT DURING CONSTRUCTION BEFORE ELEMENTS WERE HOUSED IN

Contractor moved concrete and other material to place by two cableways spanning whole 9-acre area covered by the 80 filters and coagulation basin. The bridge-like structure is the chemical storage house and runway over the mixing chambers, between the filters and the coagulation basins. Entire weight and loading are carried by piling

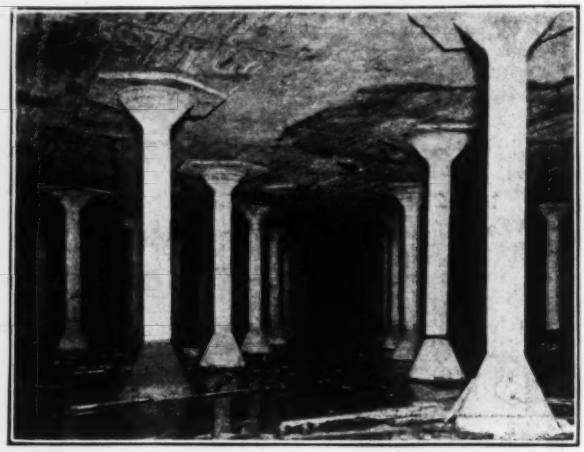


FIG. 4—FILTERED WATER BASIN WITH CIRCULAR COLUMNS AND FLARED TOPS AND BASES

coagulation basins combined cover 9 acres and the filtered-water reservoir 6.7 acres, the low-lift pumping station and intervening road making up the remainder of the area. The filter area, including beds, pipe galleries, etc., is 2.98 acres and the effective sand area is 2 acres, so that the actual filtering area is 67 per cent of the total area covered by the filters, giving a higher ratio of effective sand area to total area than exists in any other filter plant in the country, which means a greater degree of economy than heretofore achieved.

Low-Lift Pumping Station—The low-lift pumping station is a brick building, 65x175 ft. in plan, with concrete substructure, located between the filters and filtered-water reservoir, immediately over the 10-ft. diameter intake conduit, the latter being removed for the full length of the station and re-connected to the station at both ends. The water flows from the conduit into the screen chamber at the southerly end of the station, where seven electrically-operated revolving screens, each 6 ft. wide by 25 ft. high from base to normal river level, serve to intercept all coarse floating material and ice formation, provision being made for cleaning the screens while in operation. The screening element is composed of 14-gage copper wire, three meshes to the inch, which leaves clear openings about ¼ in. square, and provides a clear water-way through the screens in the ratio of six to one of the cross-sectional area of the intake conduit. From the screen

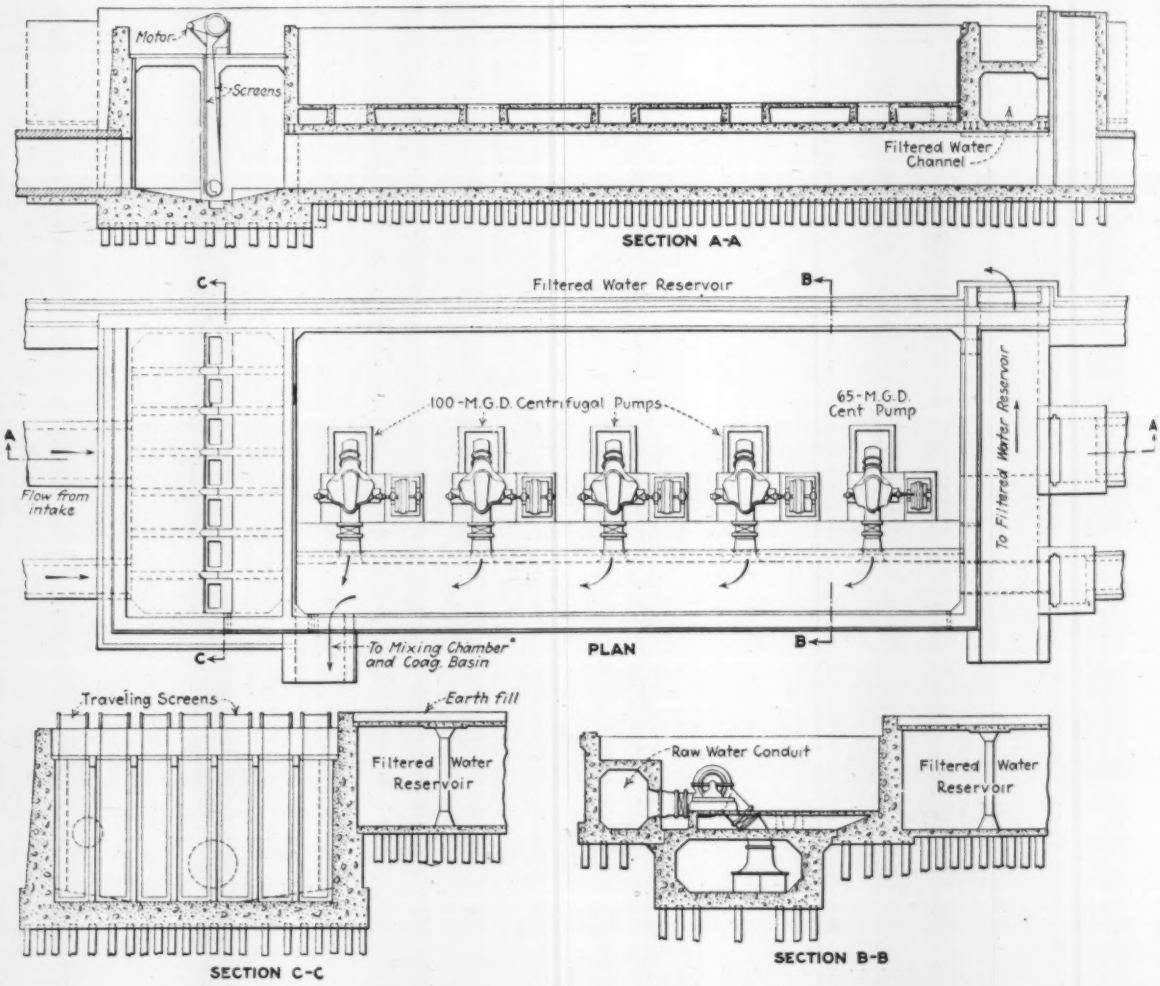


FIG. 5—LOW-LIFT PUMPING STATION FOR DETROIT WATER FILTRATION PLANT

chamber the water flows into the suction well, 26 ft. wide by 11 ft. deep, directly under the floor of the pumping station.

The station is equipped with five motor-operated centrifugal pumps having a combined capacity of 465 m.g.d., designed to deliver water to the mixing chamber of the coagulation basin against a head of about 26 ft. There are four 100-m.g.d. and one 65-m.g.d. pumps. Three of the pumps are operated by synchronous motors, and two by slip-ring motors, the latter two designed for a 10 per cent variation in speed to provide varying rates of pumpage, and automatically regulated to maintain a fixed level in the coagulation basins.

A balcony surrounds the interior of the station at the entrance level, with the pump floor 20 ft. below the ground level as a provision against excessive suction lift during periods of low water and high consumption.

Filters—The filtration works proper are all under one roof in a structure 480 ft. wide by 810 ft. long, with a three-story building at the center of the north end which forms the main entrance to the filters and constitutes the tower for the wash-water tanks. It also provides space for the chemical and bacteriological laboratory and other offices. Immediately south of the entrance building are the eighty filter beds occupying a space 480x270 ft.; and south of these are the coagulation basins, with the mixing chamber and chemical feed and storage space between the filters and coagulation basins.

The mixing chamber is considerably smaller in proportion to the capacity of the plant than those which have been provided in most recent filter installations, but it is designed to provide thorough and rapid mixing at high velocities by means of a diversified system of baffles. The chamber is 18 ft. wide and 240 ft. long,

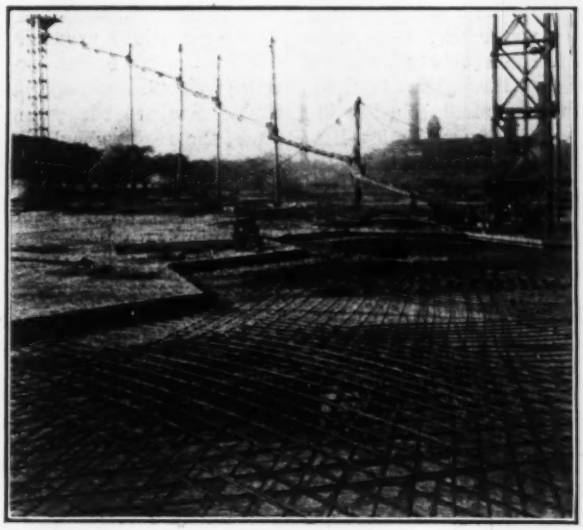


FIG. 7—THREE-WAY REINFORCING OVER COLUMN HEADS

Zigzag expansion joint in roof slab of filtered water basin, which is supported on columns spaced 2 ft. c. to c. at points of an equilateral triangle.

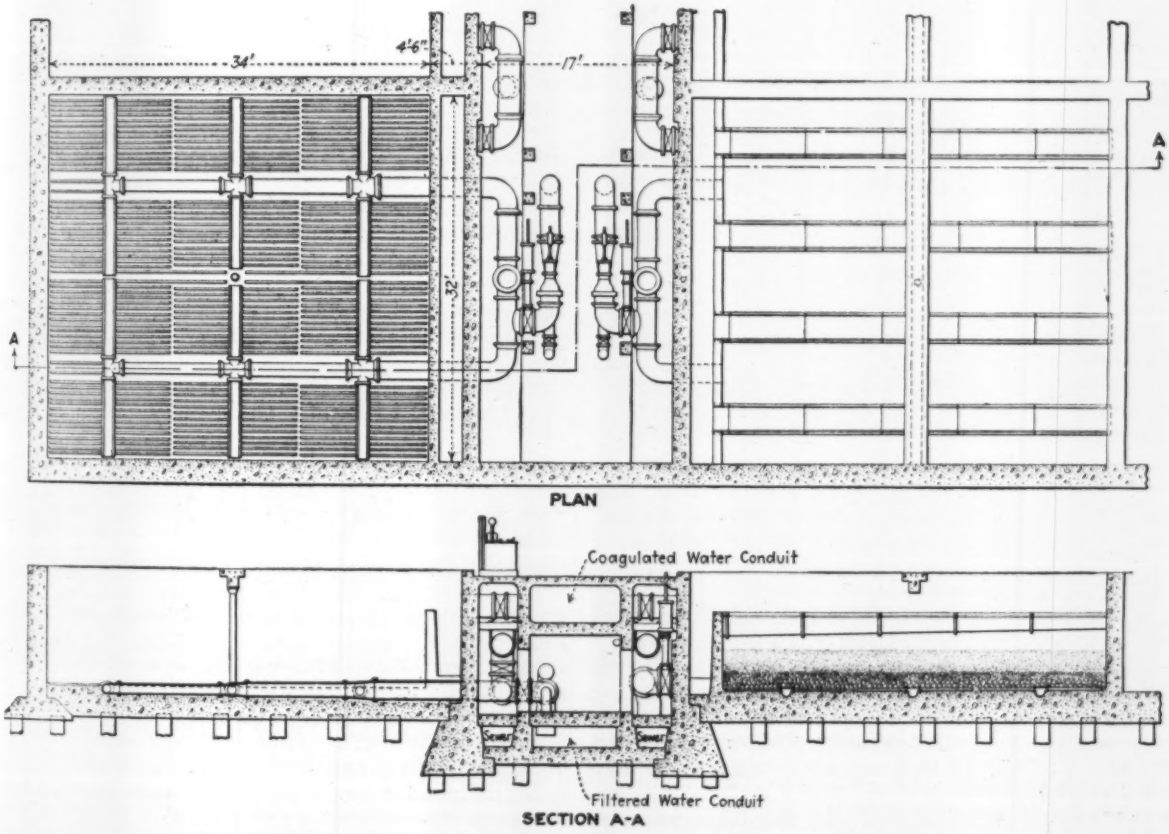


FIG. 6—PLAN AND SECTION OF DETROIT PIPE GALLERY AND FILTER BEDS

covered for the greater portion of its length so that the water may start through under a slight pressure. Alternate sets of vertical and horizontal baffles are placed throughout the full length of the channel, and as the coagulant solution is introduced where the water flows in from the low-lift station, the result should be a perfect admixture by the time the coagulation basins are reached. At maximum capacity the velocity will approximate 90 ft. per minute, and the mixing period will be slightly less than three minutes.

The space over the mixing chamber and coagulated water conduit was carried up an extra story in height to provide space for the storage of chemicals, and at the westerly end to three stories to accommodate storage bins for feeding alum into the dry-feed chemical machines. The storage space is ample for more than three months' supply of alum. Two storage bins have sufficient capacity to feed the plant for 48-hr. periods, thereby enabling the filter attendants to operate through night shifts and over holidays without manual labor for handling alum. Five storage bins were installed to permit the use of sulphate of iron and lime should future conditions make the substitution necessary, but only three dry-feed chemical machines were installed, two being required for service under maximum consumption and one for reserve.

Coagulation Basins—The coagulation basin, which is divided into two equal parts, covers a space 480 ft. wide by 525 ft. long, and has a total capacity of 30 m.g., providing a subsidence period of more than two hours when the whole plant is operated at its maximum rate. During cleaning periods, which probably will not occur more than once a year, one section of the basin will be shut off while the other section remains in operation. Each section of the coagulation basin is subdivided for the greater part of its length by a baffle wall, so that the coagulated water flows at a low velocity a distance equal to twice the length of the basin. The bottoms are sloped to low points where mud valves permit flushing the accumulated sediment into the sewer.

On account of prevailing low winter temperature, the coagulating basins are covered and a steel trussed roof type of construction was adopted as affording a better opportunity for observation of coagulating effects, and also permitting a more pleasing architectural treatment at no additional cost. This arrangement makes the external elevation of both filters and coagulation basins practically the same.

Between the coagulation basin and the filter beds there extends a coagulated water conduit for the full width of the structure, from which the coagulated water flows into each of the conduits feeding a double tier of eight filter beds.

Filter Beds—The eighty filter beds each have 1,088 sq.ft. effective sand area, divided into five double rows of eight beds, with a pipe gallery between each two rows, the operating floor forming the cover for the pipe galleries. Each bed is one-fortieth of an acre in area and has a filtering capacity of 4.5 m.g.d. at the 160-m.g.d. rate or 4.5 m.g.d. at a 180-m.g.d. rate. The filter is covered with a steel trussed roof having continuous raised monitors over the operating galleries, affording ample light and ventilation.

Arrangements for sterilization by liquid chlorine are provided over one of the filter beds on the westerly side where, if found necessary, chlorine can be introduced at the end of the main filtered-water collector before it enters the filtered-water reservoir.

All water conduits up to the point where the water is delivered onto the filter beds through 24-in. gate valves are of concrete, and in the design of these conduits the effort has been to convey the coagulated water to the beds with the least disturbance possible, to prevent the breaking up of the floc.

FIG. 8—HEAVY CONCRETE FRAME OF OFFICE BUILDING SUPPORTING WASH-WATER TANKS

Four circumferential rods around outside upright form timbers were cinched up with long turnbuckles.

The cast-iron wash-water troughs are 34 ft. long and extend from the rear end of the filter bed to the wash-water channel at the front of the gallery end of the beds. They are supported at the center from a beam which forms a walk across the middle of the beds.

The strainer system is a manifold of cast-iron pipes, branching from two main cast-iron collector pipes built partly into the concrete bottom. The collector pipes are 20 in. in diameter at the outlet, reducing to 9 in. in the manifolds, with 2-in. laterals extending from the manifolds on 6-in. centers. The main collectors, manifolds and laterals are tapped on approximately 6-in. centers for the insertion of brass strainers of the umbrella type.

The filtering medium consists of 17 in. of gravel placed around and above the strainer system, in even layers, varying in size from 2 in. at the bottom to ⅛ in. at the top, and 24 in. of sand having an effective size of 0.35 to 0.45 m.m. and a uniformity coefficient of 1.6 to 1.7.

Filtered-Water Reservoir—The filtered-water reservoir, which occupies the site of the former settling basin, is an all-concrete structure 360x810 ft. with a maximum depth of water of 16 ft. 9 in. The depth of the reservoir was limited by the elevation of existing pumping engines and other structural details of the two main pumping stations. Both floor and roof of the reservoir are of flat-slab construction, with three-way reinforcement carried from reinforced-concrete columns on 20-ft. centers forming equilateral triangles. The roof is covered with 24 in. of earth and will be seeded or sodded to form an addition to the park area; it is to be utilized for tennis courts and other recreational purposes. To conform to the general character of the surrounding grounds the ventilators will be surmounted by ornamental flowering urns.

When full the reservoir will contain 37 m.g. It will serve as a balancing factor to meet the fluctuating conditions of consumption without disturbing the prevailing rate of filtration.

General Construction—Owing to the unstable nature of the soil every portion of the filter structure, including the filtered-water reservoir, had to be supported on a pile foundation. Under the filter and coagulation basins, where the bottom was above normal river level, Raymond concrete piles were used but wooden piles were used under the filtered-water reservoir as they will always be submerged. There were 15,380 concrete piles driven for the filter plant and 14,019 wooden piles under the reservoir. The calculated pile loadings varied from 15 to 20 tons.

Bottoms of coagulation basins and filter beds are beam and flat-slab construction, the beams as well as wall footings bearing directly on piles. The base area of the whole plant is built on the ground, with the pile heads projecting up into the concrete from 6 to 12 in. No dependence was placed on the bearing value of the soil, as the entire weight of structures and contents was calculated to be carried by the piling.

Quantities—The contract for the filter substructure involved 11,000 cu.yd. of excavation, 50,000 cu.yd. of concrete, 2,200 tons of reinforcing steel, 96 tons of structural steel and 770 tons of cast-iron pipe and specials. The contract for the filtered-water reservoir comprised 43,600 cu.yd. of excavation, 32,400 cu.yd. of concrete, 1,500 tons of reinforcing steel, 48 tons of miscellaneous iron and steel and eight 60 to 64-in. gates.

All hydraulic gate valves and cast-iron piping and specials for filter connections, all cast-iron wash-water troughs and cast-iron manifolds and laterals for strainer systems were purchased and installed by the water department.

Costs—The total cost of the filtration plant, including the filtered-water reservoir but excluding the pumping station, is approximately $4,480,000; and of this amount more than $1,530,000 was expended for pile foundations, an item which normally would not have to be considered. Assuming the capacity of the plant at 320 m.g.d., and taking the full cost, including pile foundations, the result is a cost of $14,000 per million gallons capacity; or with pile foundations cost deducted, would be $9,200.

The writer acknowledges the valuable assistance given by Frank H. Stephenson, principal assistant engineer, in working out details of the filtration plans, and by Henry A. Hagen, assistant engineer for details of an architectural nature.

Southampton's New Floating Dock

Southampton's ability to cope with an over-growing volume of ocean-going tonnage will shortly be increased by the provision of a giant floating dock, according to the British Commercial Association. The new dock is of the double-sided self-docking sectional box type, consisting of pontoon and two parallel walls divided transversely into seven sections. It will have a lifting capacity of 60,000 tons. Its over-all length of 960 ft. will make it capable of receiving the largest war or mercantile vessel yet built or contemplated. The first plates were laid on the blocks at the firm's Walker Shipyard on Nov. 22, 1922, and the first section was launched from the Armstrong Yard on March 22, this year. Messrs. Sir W. G. Armstrong, Whitworth, are the builders.

Trunk Sewer Under Construction at Portland, Oregon

By W. P. Hardesty
Civil Engineer, Portland, Ore.

THERE is now being completed at Portland the second section of a sewer project that will total 7.4 miles of sewer ranging from 36 to 78 in. in diameter. The difficulty of draining the district served, the circuitous route required and the use of a long tunnel are some of the features of the undertaking.

The Willamette River is the natural discharge for sewage in Portland, but in the extreme southeast part of the city is a district of such topography that the logical direction of trunk sewer discharge is away from the river for nearly two miles. The trunk sewer for the drainage of this district is in two sections. The first section, or Foster Road Sewer, has a length of 2.2 miles and cost about $334,000. It falls southeasterly, mostly away from the main city and the river. The second section, or Lents trunk sewer, connects with the first section and runs in a general westerly direction for its length of 5.2 miles to its discharge into the Williamette River. This second section is now under construction.

Only about one-third of the route traversed is served directly by the Lents sewer. Much of it lies outside of the city limits, as much as 1¼ miles in one stretch. Advantage was taken of this condition to place the sewer at a comparatively shallow depth and to space the manholes far apart, which lightened the cost considerably.

Construction—The sewer is of reinforced concrete, mostly of horse-shoe section, top and sides 7 to 9 in. thick, bottom or invert paved with paving brick laid flat. This brick floor will facilitate repairing when abrasion shall have made it necessary.

The variation in section of the sewer, mainly to fit the size to different grade rates available, is made with only two widths. The height of the vertical walls is alone varied, using the same invert and arch, and this results in much economy of form construction and is decidedly more convenient for the contractor. Thus, with a 61-in. width the clear height varies from 53 to 74 in., while in the tunnel the width is 56 in., with a height of 71 in.

At the westerly end of the sewer the topography is such that the broad Sellwood ridge is tunneled through for a distance of 4,420 ft., to the outlet into the Willamette River. The tunnel has been driven from the two ends and from two intermediate shafts. The material is mostly gravel and boulders, with some cemented gravel and conglomerates in which blasting has been done. The unit prices for driving the tunnel in earth and in rock are $18.50 and $21.50 per lin. ft., respectively, including timber lining. The contract price for the monolithic sewer ranges from $13.40 to $16.90 per lin. ft. Trench excavation is $2 per cu.yd. in earth and $5 in solid rock.

The contract for the Lents trunk sewer was awarded to J. F. Shea at an estimated cost of $693,110. Construction was started in September, 1922, and is expected to be finished about the close of 1923. The work is in charge of O. Laurgaard, city engineer, and O. E. Stanley, assistant engineer.

Building Additional Siphons of Catskill Aqueduct

Original Single Line of Concrete-Covered and Mortar-Lined Riveted Steel Siphons Being Paralleled with Two More Lines to Give 500-M.G.D. Capacity

By Thaddeus Merriman
Chief Engineer, Board of Water Supply, New York City

CONSTRUCTION work is now in active progress on the large concrete-covered mortar-lined steel-pipe siphons at fourteen locations along the Catskill aqueduct between New York City and the Ashokan reservoir under three contracts awarded Nov. 23, 1921, by the Board of Water Supply of the City of New York (see Table I).

During the original construction of the aqueduct from 1907 to 1917 the tunnels and cut-and-cover sections were built to the full capacity of not less than 500 m.g.d., but at these fourteen locations crossing the narrower valleys the design provided for three parallel steel pipes, only one of which was installed. The work in hand is the placing of the two additional pipes at each location to bring the aqueduct to full capacity, which will be required when the additional supply is available from the Schoharie development, now also in progress.

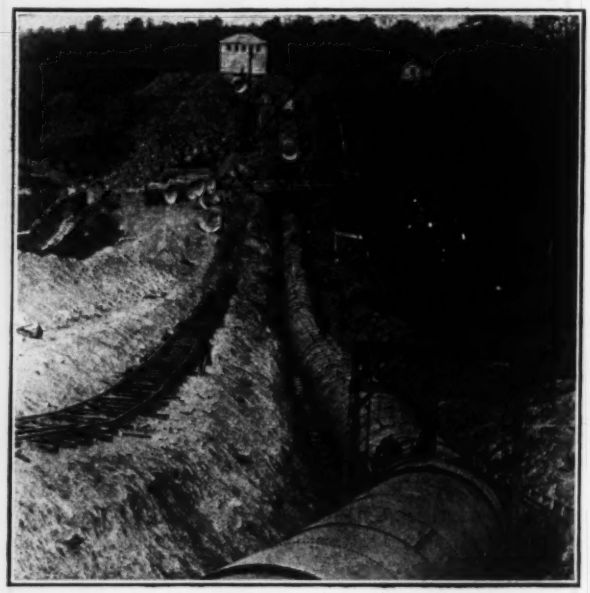


FIG. 1—LAYING 11½-FT. STEEL PIPE FOR FORT HILL SIPHON

The siphon in service is under the construction track; the third siphon will be laid at left of the first one. Note cradles and see line cut for detail.

The single pipes originally laid have had sufficient capacity under forced conditions to convey the supply available from the Ashokan reservoir up to this time. These pipes, covered with concrete and lined with mortar, have fulfilled every requirement and the success of this type of construction has been entirely demonstrated. An examination in September, 1921, after a service of seven years, of the mortar lining in the interior of the 11½-ft. Bryn Mawr siphon, which is over a mile long, and of shorter siphons, showed that the lining was in perfect condition and had afforded complete protection for the steel. The methods used in constructing the first siphons were therefore adopted for those now being placed.

The steel-pipe line, as laid, riveted and calked, is itself made watertight. The outside concrete envelope serves two purposes: (1) It holds the steel pipe in its true deformed service shape and (2) it protects the pipe from corrosion. The function of the mortar lining is principally to protect the steel from corrosion, but by smoothing up the interior the carrying capacity is increased about 25 per cent over that which would obtain in an unlined riveted pipe. Reports of experience from many places and examinations of many steel-pipe lines having failed to show that there was to be had any coating which would efficiently protect the steel of the pipe shell, reliance was placed on the protective action of portland cement on steel to secure a steel-pipe type of construction reasonably comparable in durability with the masonry portions of the aqueduct.

The protective action of the mortar lining is in large part due to the alkalinity of the cement with which the lining is made, and it may be said that as long as this alkalinity remains there will be no corrosion of the steel. This has been shown in the old cement-lined sheet-steel and iron pipes which were in vogue many years ago. Failure of these lines never occurred due to corrosion from the inside, but in nearly every case from the outside, where the acid conditions of the soil hastened the neutralization of the alkalinity in the mortar envelope.

The mortar lining itself is not watertight (very few substances are absolutely so) but it is of such density that water passes through it very slowly. Hence the dissolved oxygen carried by the water reaches the steel in very limited quantities, and such corrosive action as there will be when the alkalinity has been neutralized will proceed very slowly, since oxygen is necessary to the completion of the corrosion cycle. Practically all paint and dipped coatings tend to act as osmotic membranes and so, by the establishment of acid-alkali cells, tend not only to hasten corrosion but also to accelerate their own destruction.

At each end of each siphon there is a concrete chamber which forms the connection with the adjacent cut-and-cover or tunnel portion of the aqueduct. In each chamber, sluice-gates for controlling the flow of water into the several pipes were planned to be installed but, from the experience of several years' operation, sluice-gates are being put in only at those points which experience indicates to be desirable for operational purposes. The chambers, with their superstructures, were built under former contracts and the present work is being done between the throat castings previously placed at the chamber outlets.

A comparison of the cost of the present work, which represents the prices of November, 1921, with those of 1910-11, indicates an increase of about 46 per cent. The price for steel pipe includes the laying, testing and making tight. All pipe of ½-in. or thicker plates and,

TABLE 1.—DIMENSIONS OF CATSKILL AQUEDUCT PIPE SIPHONS

Contract 209, West of Hudson River: Rice & Ganey, Inc., New York City

Item	Siphon	Length, Ft.	Thickness of Plate, In., and Kind of Joint	Max. Head, Ft.	Diam. of Pipe Shell Ft. and In.	Cost per Ft. for Pipe Alone
7	Esopus	4,215	7/8, lap joints	107	8- 4	$25.00
7	Tongore	1,150	7/8, lap joints	72	8- 4	25.00
8	Tongore	240	7/8, long. butt joints	...	8- 4	35.00
9	Washington Square	6,550	7/8, lap joints	90	8-10	27.00
		12,155				

Contract 210, East of Hudson River to Kensico Reservoir: Frederick Snare Corporation, New York City

10	Foundry Brook	6,980	7/8, lap joints	192	8- 6	34.00
11	Foundry Brook	570	1, lap joints	...	8- 6	38.20
7	Indian Brook	1,210	7/8, lap joints	70	7- 4	33.00
10	Sprout Brook	3,530	7/8, lap joints	234	8- 6	34.00
11	Sprout Brook	910	1, lap joints	...	8- 6	38.20
10	Peekskill	6,360	7/8, lap joints	340	8- 6	34.00
11	Peekskill	785	1, lap joints	...	8- 6	38.20
12	Peekskill	4,950	1, long. butt joints	...	8- 6	38.20
13	Peekskill	1,235	1 1/8, long. butt joints	...	8- 6	41.30
9	Hunters Brook	2,975	7/8, lap joints	110	8- 4	34.00
9	Turkey Mountain	3,010	7/8, lap joints	92	8- 4	34.00
8	Harlem Railroad	1,380	7/8, lap joints	60	7-10	34.00
		33,895				

Contract 211, Kensico Reservoir to Hill View Reservoir: Thomas Crimmins Contracting Co., New York City

7	Kensico	3,240	7/8, lap joints	50	11-3	34.00
7	Elmsford	2,980	7/8, lap joints	68	11-3	34.00
7	Fort Hill	2,530	7/8, lap joints	72	11-3	34.00
7	Bryn Mawr	5,090	7/8, lap joints	214	11-3	34.00
8	Bryn Mawr	470	1, lap joints	...	11-3	40.00
9	Bryn Mawr	4,555	1, long. butt joints	...	11-3	45.00
10	Bryn Mawr	1,085	1 1/8, long. butt joints	...	11-3	48.00
		19,950				

Recapitulation

Contract	Diameter of Shell, Ft. and In.	Lin.Ft.	Estimated Cost	Estimated Cost per Foot Completed Works
209	8-4 to 8-10	12,155	$999,325	$82.21
210	7-4 to 8- 6	33,895	2,978,103	87.86
211	11-3	19,950	2,275,360	114.53

at certain places, pipe of 7/8-in. plate, have double-riveted circular joints.

Steel for the plates is made by the basic open-hearth process and fulfills the requirements for "flange steel" as given in the Standard Specifications for Boiler and Firebox Steel for Locomotives, serial designation A30-18 of the American Society for Testing Materials, and for rivets as given in the Standard Specifications for Boiler Rivet Steel, A31-14 A.S.T.M. All specimens and records are furnished and analyses and tests made as therein provided. These tests are made or records furnished the Board's inspector at the rolling mill and duplicate check samples as required are tested and analyzed in the laboratory of the Board of Water Supply.

An identifying number is stamped on each plate so that only accepted plates go to the fabricating plant. The plates for Contract 209 are rolled at the 140-in. mill of the Carnegie Steel Co., Homestead, Pa., and fabricated by the American Bridge Co., at Ambridge, Pa. For Contract 210 the plates are rolled at the 110-in. mill of the Bethlehem Steel Co., Sparrows Point, Md., and fabricated by the Merchant Shipbuilding Corporation, Chester, Pa. For Contract 211 the plates are from the 110-in. mill of the Bethlehem Steel Co., Sparrows Point, Md., and fabricated by the New York Engineering Co., Yonkers, N. Y. The total weight of steel under these contracts is 20,000 tons.

On Contract 211 the 11¼-ft. pipe is being fabricated in a plant located near the work, thus enabling delivery to be made by truck. This size is so large as to require special precautions for rail delivery, which under present conditions of traffic congestion would be difficult.

The pipes are made with alternate inside and outside courses, the nominal diameter being measured as the inside diameter of the inside course. Each course is made to lay 7½ ft. and is formed of not more than two plates and usually of one. The edges of all plates are bevel sheared, and plates ½ in. or more thick are bevel planed; all joints are calked both inside and outside. At the junction of the circular and longitudinal joints the plates are reduced to a fine edge, through which two rivets of the circular joint are driven; the material for the butt-straps is cut from across the width of full-sized plates and not in a direction parallel to their length. The work is carefully and accurately laid out and all rivet holes spaced with precision. On Contract 211 all holes are drilled to template, several plates being drilled at a time. On Contracts 209 and 210 all holes

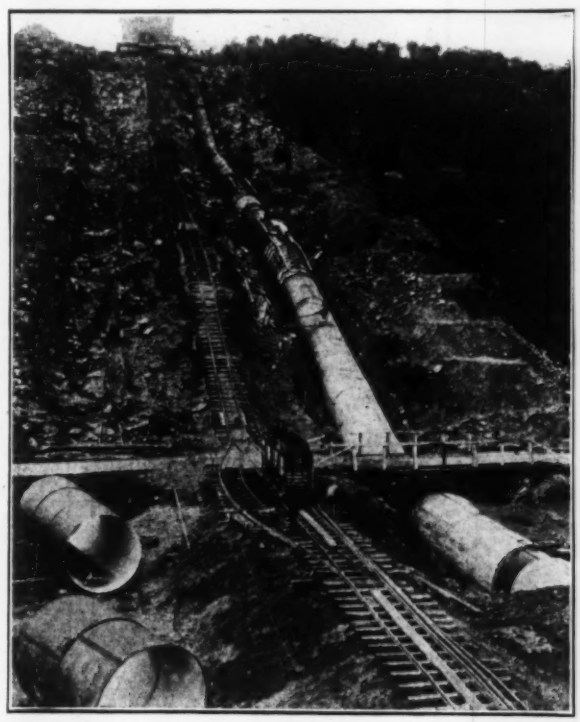


FIG. 2—CONSTRUCTING TWO ADDITIONAL SPROUT BROOK SIPHONS

Concreting east line in progress; excavations for west line under way. Note two- and three-length sections of steel pipe in foreground.

are punched in automatic gang punches. In the thicker plates the holes are sub-punched and reamed to final size.

All riveting on the shop seams is done by hydraulic or compressed-air riveters. In the field the riveting is being done with compressed-air hand hammers. All of the steel plates are pickled by dipping into a bath of dilute sulphuric acid. This bath is maintained at a strength of approximately 5 per cent by volume of oil of vitriol, and at a temperature of 125 deg. F. After sufficient time in the pickle to thoroughly remove mill scale, the plates are taken from the bath, washed and immediately dipped into a warm alkaline bath of strength sufficient to neutralize the remaining acid.

For shipment to the field two courses are usually riveted together, forming a section 15 ft. long; on Contract 210 many sections of three courses each have been made. To protect the pipe sections from the effects of weather exposure, the interior surfaces are covered with a heavy coat consisting of 50 gal. of heavy lime

whitewash, 20 lb. of glue dissolved in water and 50 lb. of portland cement. The exterior surfaces of the pipes are sprayed with a thin coating of boiled linseed oil. Both of these coatings are of a temporary nature and serve only to reduce the labor of cleaning the surfaces before the concrete and mortar are placed. The whitewash coating is removed by brushing and scraping before the mortar lining is put in, while the linseed-oil film is both rubbed off by the mechanical abrasion during the pouring of the concrete and dissolved by the alkalinity of the concrete.

Manhole and blowoff connections are made of cast steel and all blowoff valves and other valves immediately adjacent to the pipe are of solid manganese bronze. Because of the severe buckling and tearing strains which the large thin-shelled pipes undergo when being first filled with water, heavy reinforcing collars and plates are provided. The steel castings are of material conforming to the standard specifications of the A.S.T.M. for Class B, Steel Castings, serial designation A27-16, but the sulphur is held so as not to exceed 0.05 per cent. Contact surfaces of flanges of manhole

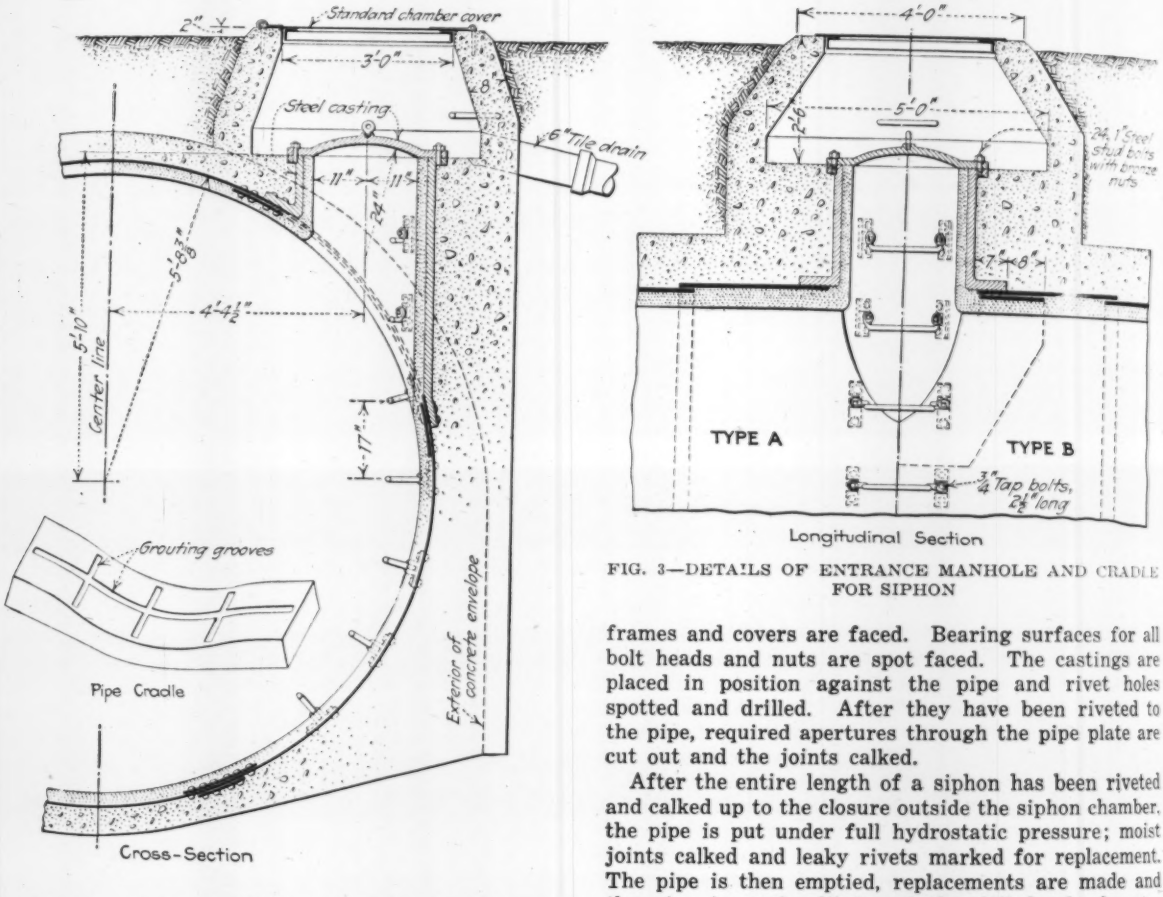


FIG. 3—DETAILS OF ENTRANCE MANHOLE AND CRADLE FOR SIPHON

frames and covers are faced. Bearing surfaces for all bolt heads and nuts are spot faced. The castings are placed in position against the pipe and rivet holes spotted and drilled. After they have been riveted to the pipe, required apertures through the pipe plate are cut out and the joints calked.

After the entire length of a siphon has been riveted and calked up to the closure outside the siphon chamber, the pipe is put under full hydrostatic pressure; moist joints calked and leaky rivets marked for replacement. The pipe is then emptied, replacements are made and the pipe is again filled and the full head of water maintained during the placing of the concrete envelope. In a number of cases intermediate bulkheads were used.

The concrete envelope has a minimum thickness of 6 in. at the crown, increasing to about 8 or 10 in. on the horizontal diameter, where the outside limit of concrete drops vertically to the subgrade. Concrete is placed in most cases from a traveling concrete plant which is shifted along on the central pipe already in service, and the concrete chuted directly from the mixer into the forms. The plant is served by gasoline locomotives hauling trainloads of six 1-yd. batches of materials. A Koehring paver is used at one location. About 70 lin.ft. of envelope are placed per day and the maximum poured was 140 ft. in 8 hr. The concrete mix is 1 cement: 1.5 sand: 3.8 gravel or broken stone varying to 1:2:4, the proportions being by volume, the mix being varied so as always to secure a cement factor of 1.5 barrels per cubic yard of concrete. A number of strength

The first field operation is the removal of top soil, which is stored for surface dressing. The trench is excavated to subgrade and concrete cradles are built at grade 7½ ft. c. to c., one at the center of each pipe course. The cradles are 6-in. minimum thickness of concrete, 2 ft. in length of trench and nearly full trench width (see Table II for dimensions). The surface is formed to a curve, the radius of which is slightly greater than the nominal pipe curvature. A 1x1-in. grout channel is formed in the surface with three cross channels.

TABLE II—DIMENSIONS OF CONCRETE CRADLES

Nominal Diameter of Steel Pipe, Ft. and In.	Chord of Cradle, Ft. and In.	Radius of Steel Pipe, Ft. and In.	Radius of Cradle, Ft. and In.
7– 4	5–7	3– 8	4–2½
7–10	5–9	3–11	4–4½
8– 4	6–0	4– 2	4–7½
8– 6	6–1	4– 3	4–8½
8–10	6–5	4– 5	5–3
11– 3	9–2½	5– 7½	7–0

tests have been made on the concrete and these tests point to the advisability of specifying strengths, as has been done in many contracts for highway work. Upon the completion of the concrete cover, and after it has attained sufficient strength to resist the stresses incident to the unwatering, the structure is ready for the mortar lining. The function of the concrete covering is twofold: (1) It serves to prevent corrosion; (2), and most important, it holds the steel shell very nearly to the shape which it will have when in service. The outer concrete, therefore, makes possible the use of the thin interior mortar lining which of itself could

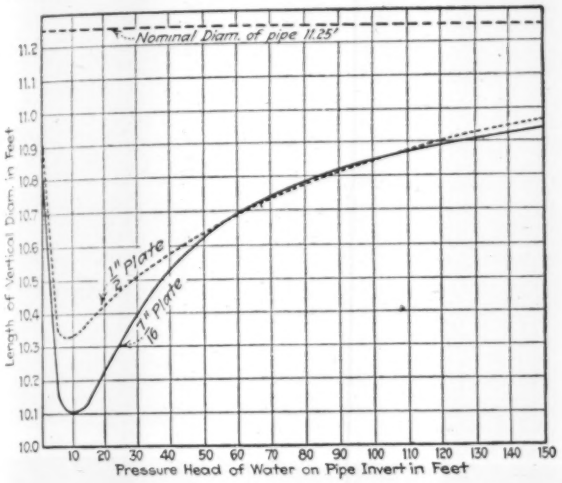


FIG. 4—CHANGES IN VERTICAL DIAMETER OF UNPROTECTED 11¼-FT. STEEL PIPE

not resist the stresses due to the distortions resulting from the change in conditions from a pipe empty to one full and under pressure.

The mortar lining is 2 in. thick measured from the inside of the inner course of pipe. It also extends into the manhole castings and the blowoff elbows. The lining consists of portland cement and sand mixed in ordered proportions, 1 part cement to from 1 to 2 parts sand if the mortar is poured into forms. The mix now in use is 1 cement to 1½ sand by volume. The water content is regulated so as to secure a mixture which will flow readily but yet which will have a minimum water content.

The lining is placed by pouring the grout mortar into the space between the pipe shell and an interior form through 2½-in. holes provided in the steel shells at the uphill end of each outside course. These grout-hole openings are closed so as to be watertight after the lining has been completed by threaded cast-steel plugs. These holes are reinforced by plates riveted on and calked, except for holes 2 in. or less in diameter in ⅞-in. plate.

During the progress of the work a number of measurements and observations have been made, the results of which are of general interest. Changes in length due to temperature variations were observed as shown by Table III.

These steel pipes, due to their changes in length with temperature, always tend to creep in the direction of least resistance. In one case there was a movement of 15 in., and in another case a length of 540 ft., laid on a slope of 19 deg., moved downhill 8 in. and was

TABLE III—TEMPERATURE CHANGE IN LENGTH

Pipe Diameter, Ft. and In.	Length, Ft.	Temperature Change, Deg. F.*	Expansion, In. Observed	Theoretical†
8–10	3,078	15	3	3⅛
8–10	3,078	20	4–5	4⅛
8–10	3,078	25	6–7	6
8–10	3,078	30	7	7⅛
8–6	807	19	1¾	1¾
8–6	807	30	2¼	2
8–6	1,292	15	1¼	1⅜
8–6	1,292	24	2¼	2⅛
8–6	1,292	33	3¼	3⅛

* Mean of atmospheric temperatures inside and outside the pipe. † The theoretical expansion was computed with a coefficient of 0.0000072.

held in position only by the adoption of special measures. Nearly all movement of this nature may be avoided by laying upward both ways from the valley bottom.

As the pipes are laid in the trench they flatten down, due to their own weight. Then as they are gradually filled with water the flattening increases until they are just about full. Above this point, as the pressure increases the flattening decreases, but the pipe never assumes a truly round form. The accompanying diagram shows the average results of a number of observations on the natural deformations of the 11¼-ft. diameter pipe with plate thicknesses of ⅞ and 1 inch.

The work in the field is being supervised for the Board of Water Supply by Charles M. Clark, department engineer; Howard P. Barnes and Cornelius J. O'Connor are the division engineers. The designs are prepared in Headquarters Department, of which Walter E. Spear is department engineer. Fred F. Moore is designing engineer and L. Bernard Stebbins is assistant to the chief engineer.

Sprinkler Heads in Automatic Fire Protection Systems Need Care

By C. C. Brown
California & Hawaiian Sugar Co., Crockett, Calif.

A RECENT test of 5,000 sprinkler heads of various ages and makes in the fire-protection system of a large Western industrial plant showed an interesting variety of conditions. Some heads had remained effective and ready for service for twenty-five years, but many not so old had deteriorated so as to be inoperative or had developed leaks. After a series of tests on heads taken out of service it was decided that heads in locations exposed to salt air or to deposits from manufacturing processes should be dipped in a suitable protective solution before installation and should thereafter be inspected every few months.

Some of the heads had suffered mechanical injury that bent or jammed the parts and in others solder holding the release bars had come loose, but most defects were due to leaks and the resultant formation of corrosive deposits. Cleaning these corroded heads only increased the leakage. Leaky heads were therefore all replaced.

Where corrosion was found to be due to external causes the heads were cleaned and before replacement were dipped in a protective solution made of 2 parts boiled linseed oil, 3 parts rosin and 7 parts paraffine, all ingredients being measured by weight. This solution was melted together at a temperature of about 190 deg. F. and clean new heads were dipped into it quickly. The covering dries quickly and affords a corrosion-proof coating effective for many months.

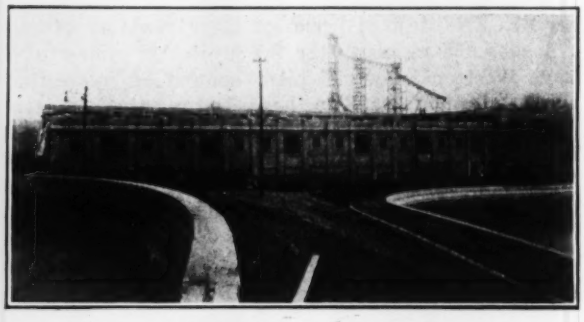
Water Filtration Plant for Omaha Metropolitan District

High Consumption Overtaxes Settling Basins—Filter Building on Separate Footing—Stools in Underdrains Save Gravel

By F. P. Larmon
Chief Engineer, Metropolitan Utilities District, Omaha, Neb.

NOVEL concrete stools in the underdrain system of the new Omaha (Neb.) water filtration plant make every 2 sq.ft. a miniature isolated system fed by four ½-in. openings. Non-occurrence of gravel in the vicinity of Omaha and high freight rates to bring it in were another factor leading to the use of the stools. Other points in this latest of filter plants on which construction is being rushed include an extra wide pipe gallery for easy access to the piping and the construction of the filter house separate from the filters.

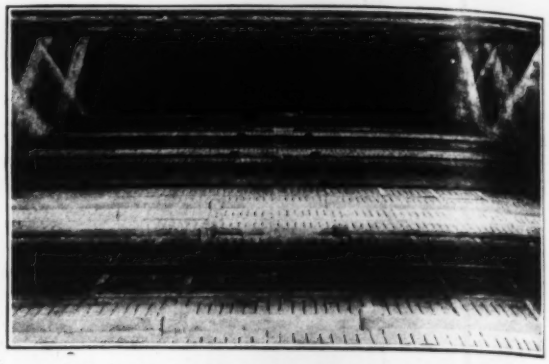
The present water plant was built in 1881 and up to this time the water, which is taken from the Missouri River, has been treated by sedimentation through a series of seven basins. The latest basin, which was built two years ago, was designed at that time for use as a clear-water basin for the new filter plant. In 1922 the pumpage reached 35 m.g.d. and the river water had such a high turbidity that it was impossible to furnish satisfactory water by plain sedimentation. On Sept. 6, 1922, the board of directors of the Metropolitan Utilities District authorized the construction of a filter plant having an initial capacity of 50 m.g.d. and so designed that it can be extended later to 100-m.g.d. capacity. Work on the plans began immediately, and nine days after authorization construction was started. By January the main building had been inclosed, the head house carried up to the tank floor and work was well under way for the interior conduits and filter beds.



GENERAL VIEW OF PLANT

After careful investigation it was decided to follow closely the lines of the Chain-of-Rocks filter plant at St. Louis and put in twelve filter beds of 1,400 sq.ft. effective area. These beds are rated at 4 m.g.d. each, although it is expected that, on account of the large settling basins, this rate may be increased 25 per cent. The ultimate plan calls for the head house in the center, with twelve beds extending to the south and twelve beds of the future addition extending to the north. The head house and conduits are designed for the ultimate 100-m.g.d. requirements. The building is designed with a concrete frame, columns and roof. The side walls are to be of light gray brick with steel sash and wire-glass windows. The present structure is 130 x 242 ft. in plan.

On account of the necessity of early completion of this plant, it was decided to construct the building and the filter apparatus entirely separate, putting up the building first and carrying the supporting columns on separate foundations, later installing the beds between the columns. The wisdom of this arrangement was proved by the fact that it was necessary on account of soil conditions to put in the column foundations at different depths. Erection of the building first meant the saving of three months' time and will put part of the plant in operation in the early summer.



CONCRETE BLOCKS AND STOOLS FOR FILTER UNDERDRAINS SYSTEM

Slots in top of stools distribute wash water evenly to underside of the 8-in. gravel layer supporting the sand bed.

The present sedimentation basins extend in a row from north to south and a conduit will be constructed to the west of these basins, so arranged that the water for the filter plant can be taken from any one of the first six basins. This arrangement will give the plant great flexibility and permit the shutting down of any one basin for cleaning or for repairs without interference with the operation of the others or of the filter plant.

The Pipe Gallery—This extends through the center of the building and is 23 ft. wide in the clear. The conduits are of concrete. On the lower level is the effluent conduit with drains for carrying off the wash water located on each side, and the conduits for delivering the wash water to the bed on the outside. The top of these conduits forms a floor the whole width between the beds, the only obstruction being the control piping, which is arranged with a view of making it compact and also easy of access. Seven feet above the effluent conduit is the bottom of the influent flume, the top of which will furnish the floor of the main corridor. From the influent flume a 24-in. line leads to each bed and is controlled by a hydraulically-operated valve. The waste-water piping is taken from the side of the influent line and leads diagonally down to the drain. Filtered water is taken from the two halves of each bed by a 20-in. pipe, joined in the center to a 24-in. pipe which leads through a rate controller and then down into the top of the effluent conduit. The wash-water connection is situated directly under the junction of the two 20-in. lines. A 6-in. re-wash connection is also provided.

The Filter Beds—These are 50 ft. long and 33 ft. wide, divided through the center by an open conduit for the distribution of the inflowing water and for the collection of the wash water. The collecting troughs will be of concrete and of horse-shoe section with a rounded top edge.

Under the center of each half of the bed is a closed

concrete conduit for collecting the filtered water. In the top of this conduit, 2 ft. c. to c., are special cast-iron tees from each side of which lead 3-in. pipes forming the collection system. These collecting pipes are drilled four holes to the foot and fitted with ½-in. brass bushings. Between the pipes will be laid a concrete filter bottom recently brought out by the International Filter Co., consisting of concrete stools and partition blocks so arranged that each 2 sq.ft. of filter bed will be fed by four ½-in. holes, the water passing through the holes in the distributing pipes and under the concrete stools, then up through the slotted top. The partition blocks are so arranged that the water must pass up through or alongside of each concrete stool but cannot flow into the adjacent compartments. It is believed that this type of filter bottom will give satisfactory results and practically eliminate the formation of mud balls. On top of these concrete stools will be spread 8 in. of gravel graded from 1-in. down. Over the gravel will be spread 24 in. of sand. Experiments have shown that washed sand from the Platte River can be used without any preparation and after two or three washings and a light scraping will give a well graded and satisfactory filtering medium. On account of the lack of any gravel in this vicinity the cost due to freight is high. The thin gravel layer permitted and the wide spacing obtainable by the use of these stools will make this bottom much cheaper than the usual bottom obtained by placing the piping on 6-in. centers and using 12 to 18 in. of gravel.

Wash-Water Tanks—On the second floor of the head house will be placed the concrete wash-water tanks, with ample capacity to wash three beds without refilling. A large high-pressure supply main passes near the filter house so that it is possible to use a centrifugal pump driven by a water turbine for filling the wash-water tanks from the effluent conduit.

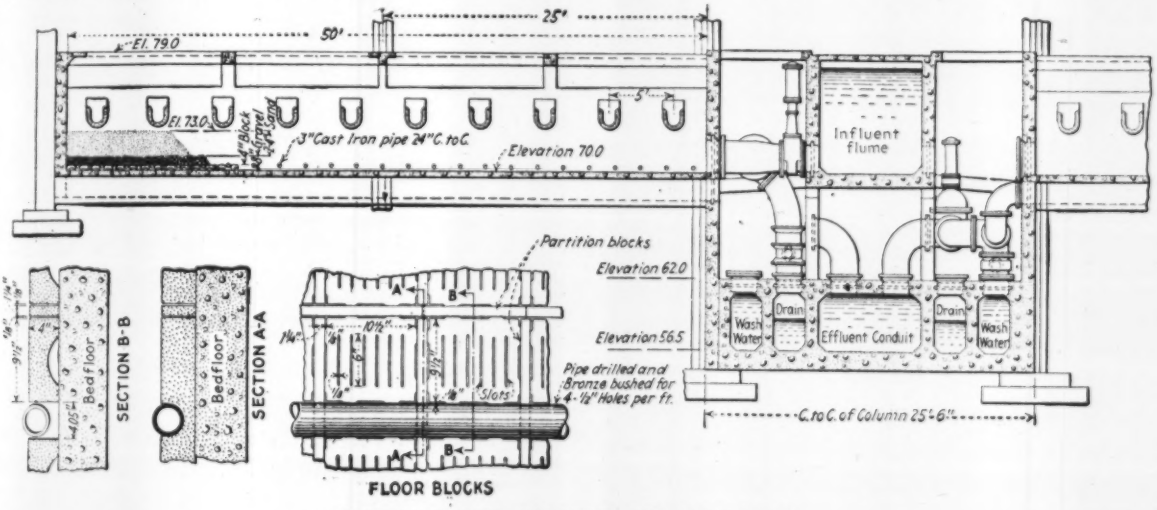
Operating Tables—The material will be gray Tennessee marble, with a green marble base, a departure from the usual custom being to make the front a solid marble panel and to place the manifolds and four-way valves below the main floor instead of within the tables. This will eliminate the possibility of any leakage from these valves or manifolds onto the main corridor and also put them in a place easy of access for repairs or adjustment.

Heat and light will be taken from the main pumping station, which is located 500 ft. north of the filter plant.

By the middle of May the main building had been erected, the head house and wash-water tanks completed and three of the filters put into service. By June 1 three more will be ready. All work on the plans and construction has been done by the department of engineering and construction of the Omaha Metropolitan Utilities District under the general direction of the writer.

European Railway International Relations

With the purpose of improving the confused conditions of international railway traffic in Europe due to the hard feelings and many frontier changes following the World War, an International Railway Commission was organized at Paris in October, at a conference of representatives of about twenty-six countries. The meetings were held at the house of the French Society of Civil Engineers and were presided over by Mr. Mange, general maanger of the Paris & Orleans Ry. Mr. Mange was later elected president of the permanent organization, with Mr. Leverve as general secretary. The official name is the International Railway Union, with offices at Paris. Membership is limited to railways having not less than 628 miles of standard-gage track in Europe or connected with European lines. It is expected that Japan and China may be admitted when the Trans-Siberian Railway is reopened. Smaller lines and narrow-gage lines may be admitted if of sufficient importance in regard to international traffic. The number of votes of delegates varies with the mileage which they represent. Certain transport undertakings, railways or otherwise, not eligible for membership but having international traffic relations with member railways, may become "adherent administrations." Meetings are to be held every five years. A board of management to administer the affairs of the organization will be composed of twelve member railways, who will appoint a chairman and three vice-chairmen to handle ordinary business matters. Decisions may be made when seven members of the board are present. Five committees have been appointed to deal with special subjects as follows: (1) Passenger traffic; (2) freight traffic; (3) reciprocal accounts and exchange; (4) interchange of rolling stock; (5) technical affairs.



SECTION OF PIPE GALLERY AND ONE FILTER

Right Method of Paying for Water for Fire Protection

Municipal as Well as Private Works Should Get Cost of Service from Taxpayers—Hartford Figures Illustrate Some Points

By Caleb Mills Saville
Manager and Chief Engineer, Water-Works, Hartford, Conn.

IN CONSIDERING the value of the fire-protection service furnished a municipality by its own water department the question is often raised as to whether there should be any payment. Arguments, more or less specious, are made to the effect that the cost of this service should be included in the water rates or disguised in any way that will prevent its appearance as an item in the budget on which the tax levy is to be based. The consensus of public utility rulings considers a municipal water department as a separate entity, distinct from other functions of government and required to finance its own operations. Accepting this construction it readily follows that it is essential that a water-works system, whether owned by the municipality or privately, receive adequate return for value furnished. It is then important to determine the facts on which to base a method for proper and reasonable return for the service furnished.

Among the ways for meeting payment for fire protection service are: (1) A unit charge per hydrant in service. This is perhaps the most common method, although it has little or no rational basis in fact, because the number of hydrants is no measure of the amount of money invested in the water-works for fire-protection purposes. (2) A unit charge per capita of population is sometimes made. This also is illogical, because there is no direct connection linking population, property value, and water department expenditure for fire protection. (3) The method most approved by public utility commissions in rate making decisions is a composite charge consisting of a unit charge per hydrant for maintenance and depreciation, plus another unit charge for pipe capacity and other costs of excess service per linear foot of pipe in service.

The total amount which a city should pay to its water department for fire-protection service may be obtained as follows: (1) Ascertain the proportion which the extra cost of the water-supply system, due to its fire-protection service, bears to the total cost of the works. (2) Determine the annual amount necessary to operate the works, including interest and sinking fund payments, and of this total allocate that portion to fire protection which the extra cost due to fire-protection features is to the total cost of running the works. To find these proportions accurately for any individual water system requires much expenditure of time and money.

Fortunately there are on record many rate cases where these determinations have been made and ratios can be established for the average case which are sufficiently accurate for general use or for a preliminary estimate. These studies show that the smaller the town the larger the proportional charge for fire protection. For example, for a town of 10,000 inhabitants, 60 per cent of the total cost of the works is found to be for fire protection, while for a city of 300,000 only about 13 per cent of the total cost is thus allocated. In the case of the Hackensack Water Co., before the New Jersey Public Utility Commission in 1917, the proportion of the gross charges for water service chargeable to fire protection was found to be 12.5 per cent. In the case of the Queens County Water Co., New York, before the Commissioner of Water Supply, Gas and Electricity (1915), the total value of the works was found to be $2,000,000, of which 23.2 per cent was attributed to fire protection. It was also found that 15 per cent of the operating expenses were incurred on this account.

The only bearing that the number of hydrants has in the making up of the fire-protection cost is in the annual charge for maintenance and depreciation of these appurtenances. The method of placing a per capita charge for fire-protection service of the water department, while less in evidence than the hydrant charge, is also illogical and probably an accompaniment of the nearly obsolete fixture charge for water supply. It appears just as reasonable to charge a per capita rate for household service regardless of the amount used as to charge for fire protection regardless of property defended.

Generally speaking Hartford is much better served with hydrants than many larger cities. This condition, however, is reflected, among others, in the lower rates for insurance enjoyed in Hartford, which is one of the very few cities placed in "Class A" by the National Board of Fire Underwriters.

In Hartford, during the working season of 1922, the cost of hydrant installation and replacement, including 20 per cent overhead charges, was:

21 new hydrants installed on new mains at an average cost of $165 each; range, $117 to $208.
15 new hydrants installed on old mains at an average cost of $250 each; range, $158 to $273.
29 hydrants replaced with new ones because of obsolescence at an average cost of $205 each; range, $104 to $258.
The 36 new installations averaged about $200 each.

The effect of the increased cost of labor and materials on hydrant installation cost in Hartford, using 1910 as a base, is shown by the accompanying diagram.

TABLE I.—TENTATIVE DISTRIBUTION OF HYDRANT WORK COSTS BETWEEN CITY DEPARTMENTS

	Total Cost per Year	Street Department: Portion of Total	Street Department: Amount	Street Department: Per Hydrant	Fire Department: Portion of Total	Fire Department: Amount	Fire Department: Per Hydrant	Water Department: Portion of Total	Water Department: Amount	Water Department: Per Hydrant
Inspection regular	$2,200	¾	$1,320	$0.75	¼	$440	$0.25	¼	$ 440	$0.25
Inspection special	3,700	none	none	none	all	3,700	2.15	none	none	none
Repairs	2,100	¾	1,260	0.75	¾	420	0.25	¼	420	0.25
Depreciation and obsolescence	8,000	¼ *	1,000	0.60	¾	7,000	4.10	none	none	none
	$16,000		$3,580	$2.10		$11,560	$6.75		$860	$0.50

*¼ Depreciation ¼, on basis of 400 hydrants used by Street Department and their life shortened to 25 years as compared with 40 years life for remainder.

Total of 31 hydrants were replaced because of depreciation or obsolescence during 1921. The average for the last five years has been 33 per year, with 1712 hydrants in service as of Jan. 1, 1923.

Total number of hydrants repaired from March 1, 1921, to Jan. 1, 1922, and their use so far as it has been possible to distribute it:
Total hydrant repairs 257
Of the hydrants repaired:
34 were used during the year by Fire Dept.
75 were used during the year by Street Dept.
20 were used during the year by both Fire and Street Depts.
66 were used during the year by Water Dept. for commercial purposes.
62 for which there is no record of use.
257 total hydrants repaired.

While the total cost of hydrant maintenance is available from department records, it is impracticable to make a close division of this cost among the principal city departments using them without knowing how much of this cost is due to surreptitious use by unauthorized persons. The accompanying table gives a tentative allocation of the total maintenance cost which, while de-

TABLE II—RELATION BETWEEN WATER RENTS AND PROPERTY VALUES AT HARTFORD

Classification	Amount Paid for Water per Year	Assessed Valuation of Property	Amount Paid for Water per Year per $1,000 Valuation
I—Laundries			
1	$1,376.94	$63,400	$21.70
2	1,183.44	9,300	127.00
3	702.72	34,700	20.20
4	1,462.44	29,400	49.70
5	1,529.46	29,700	51.40
Totals and average	$6,255.00	$166,500	$37.55
II—Apartment houses			
1	$243.00	$117,100	$2.08
2	254.76	124,000	2.05
3	1,206.48	419,800	2.87
4	177.96	104,500	1.71
5	267.36	126,800	2.10
6	288.48	127,500	2.35
Totals and average	$2,438.04	$1,019,700	$2.39
III—Manufacturing plants			
1	$5,264.22	$2,442,700	$2.16
2	1,665.66	1,098,500	1.15
3	2,191.20	2,122,900	1.03
4	981.72	298,500	3.29
5	1,414.68	853,500	1.66
Totals and average	$11,517.48	$6,816,100	$1.69
IV—Department stores			
1	$1,774.80	$2,038,100	$0.87
2	2,101.20	2,341,000	0.90
Totals and average	$3,876.00	$4,379,100	$0.89
V—Office buildings			
1	$533.16	$1,200,000	$0.45
2	422.71	941,000	0.45
3	1,539.19	2,587,500	0.59
4	57.36	348,000	0.16
5	1,182.00	1,331,400	0.89
6	1,218.69	3,106,000	0.39
Totals and average	$4,953.11	$9,513,900	$0.52
Grand totals and average	$29,039.63	$21,895,300	$1.33

rived from observation and inquiry, is thought to be sufficiently close to actual facts to warrant its use as a basis for hydrant charge.

How the excess investment for fire protection shall be paid for is the question that has bothered many public service commissions. Stripped of the varying camouflage that has been built up from time to time for ulterior purposes the matter may be resolved into at least two distinct issues as to payment for this service: (1) Shall consumers bear the burden by means of increased water rates? (2) Shall property be assessed in proportion to value received?

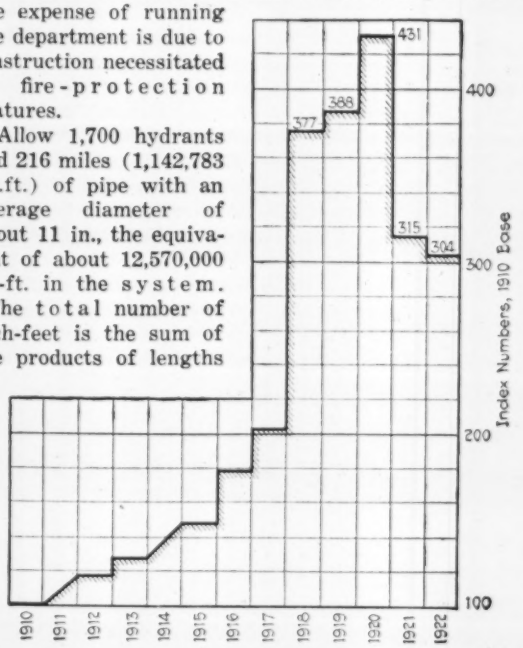
The most equitable method for defraying the cost of fire-protection benefit is its inclusion in the general tax laid against property. While the actual rate increase would be small if the cost of fire protection were placed on consumers, because of being so widely distributed, yet its imposition has by public utility commissions been held unfair, inequitable and discriminatory. The fallacy and inequality of putting the cost of fire protection on private consumers is evident when it is considered that oftentimes high-value buildings use so little water that their contribution to the cost of fire protection, based on rate payments, would be negligible compared with the amounts paid by low-value buildings using large quantities of water. This is shown by Table II, based on Hartford Water Department records.

To study the effect of the two methods of fire protection, assume a city with the following conditions:

Grand list (taxable property) $300,000,000, with a tax rate of 20 mills to provide for a budget for all municipal purposes except the water department, which must finance itself from its income from water sold.

Assume also that the income necessary properly to care for operating expenses, maintenance, depreciation, interest and sinking fund is $720,000; and that a careful analysis of conditions shows that 12.5 per cent of the expense of running the department is due to construction necessitated by fire-protection features.

Allow 1,700 hydrants and 216 miles (1,142,783 lin.ft.) of pipe with an average diameter of about 11 in., the equivalent of about 12,570,000 in.-ft. in the system. (The total number of inch-feet is the sum of the products of lengths



INDEX NUMBERS FOR COST OF HYDRANT INSTALLATIONS AT HARTFORD, CONN., 1910-22

of the different sizes of pipe by their respective diameters in inches.

Income to be derived for fire protective service $90,000. If this amount is to be obtained from water rates it means an increase of 12.5 per cent in water rates. If applied to the subtotals in Table II, the increase is similar, ranging from 0.7c. to 53.7c. per $100 valuation, depending on the character of the premises served. If the amount is to be obtained from the tax levy, it means an increase of 1.5 per cent or about three-tenths of one mill ($0.0003) and places a uniform rate on all property of 3c. per $100 property.

This cost of fire-protection service furnished by the water department through installations made solely for that purpose may properly be compared with the cost of ordinary fire insurance, which for the class of property listed in Table II would cost from 10c. to 15c. per $100 value insured.

An approved method of charging for the service is:

Total fire protection charge	$90,000
1,700 hydrants at $10 (assumed for maintenance)	17,000
Difference to be obtained otherwise	$73,000

The inch-foot charge seems to be the basis best adapted to meet conditions, as it recognizes both extension of system and size of pipes laid. In this case the unit inch-foot charge would be $73,000/12,570,000 = $0.00582 or about 0.58 cents.

A summary of the most logical method for dealing with the allocation of the cost of fire-protection service provided by the water system is well set forth in the following excerpts from decisions of public utility commissions:

The cost of standing ready at all times to furnish public fire protection should be borne entirely by the city and paid

for from the general tax levy, while the cost of supplying potable water for general consumption should be borne by the individual consumers.—*Re* Kenosha Wis. Pub. Utility Rept., 1918, D, p. 751.

The fire costs are largely fixed. These costs should be met by charges based on the proportion of plant and system required for fire protection exclusive of hydrants, and an additional charge (for maintenance, depreciation and replacement—C.M.S.) for each hydrant. The first element of this charge is proportional to the inch-feet of main in the piping system.—*Re* Hackensack Water Co., N. J. Pub. Utility Comm. April 28, 1917, p. 35.

Aeration Experiments for Removal of Carbonic Acid

Various Types of Apparatus Tested on Memphis Artesian Water Supply—Multiple-Tray Coke Scrubber Adopted

BY WELLINGTON DONALDSON
Of Fuller & McClintock, Engineers, New York City

AN INVESTIGATION of the water supply at Memphis, Tenn., by Fuller & McClintock in the winter of 1921-22 resulted (as reported in *Engineering News-Record*, Oct. 5, 1922, p. 566) in a recommendation to continue the use of ground water but to install purification facilties for removing the dissolved iron and free carbonic acid (carbon dioxide) present in the water in objectionable amounts. Recommendations for complete new works included the use of air-lift for pumping the wells. One of several factors favoring the air-lift is the fact that the ground water contains about 110 p.p.m. of free carbonic acid (expressed as CO_2) of which amount the air-lift removes incidentally 75 to 80 per cent, as determined at numerous installations in the city. The remaining 25 to 30 p.p.m., though not uncommon in public supplies, was regarded as undesirable in view of the low hardness of 40-60 p.p.m. of the well water and its marked "aggressiveness" which has made necessary the adoption of all-lead or brass plumbing in the city. To eliminate the corrosive effects of the water, it was considered important to further reduce the carbonic acid to a residual of 10 p.p.m. or less by some form of aeration, followed by a small dose of lime if complete removal should be found desirable.

A comparison of aerating devices used in connection with typical ground-water or iron-removal plants indicates wide diversity in design and quite variable efficiency as regards removal of carbonic acid. In some installations, as for instance at Lowell, Mass., the degree of oxygen saturation rather than the amount of carbonic acid is the controlling factor. In most installations, however, it is evident that the maximum removal of carbonic acid was desired. The meagerness of reliable data on the efficiency of aerating devices for decarbonation is probably due to the readiness of the dissolved gas to escape from drawn samples, making undependable any determination not made on the ground with special precautions against loss in sampling and analysis.

The reported performances in decarbonation by some typical ground-water installations are given in the accompanying table.

TABLE I—REMOVAL OF FREE CARBONIC ACID BY AERATION

Locality	Type of Aerator	CO_2 in P.P.M. Raw	CO_2 in P.P.M. Aerated
Middleboro, Mass.	Spray over 10 ft. coke bed	41	4
Superior, Wis.	Stack of 4 perforated trays	12	4
Shelby, Ohio	Stack of 3 coke trays	48	16
Xenia, Ohio	Stack of 3 coke trays	30	10
Far Rockaway, N. Y.	Single large riser pipe	30	12
Rockaway Park, N. Y.	11 wooden steps	55	31
Long Beach, N. Y.	Spray nozzles	38	11
Lowell, Mass.	2 in. riser pipes and 10-ft. coke bed	23	13
Virginia Beach, Va.	Spray nozzles	125	29
Excelsior Sps., Mo.	Multiple spilling pans	73	30

With a view of determining for the Memphis conditions what type of aerator would give the desired reduction in CO_2 with minimum head loss and floor space, outdoor experiments were conducted, at the Central Ave. pumping station, which is equipped with air-lift and furnishes normally one-fourth of the supply of about 13 m.g.d. This water contains from 25 to 32 p.p.m. CO_2 as against an average of 110 p.p.m. in the main Auction Ave. station supply.

FIGS. 1 TO 5—AERATION DEVICES FOR DECARBONATION EXPERIMENTS AT MEMPHIS, TENN.
1. Triple-tray coke scrubber with 2-in. meter on supply pipe. 2. Metal pan with perforated bottom. 3. Simple 2-in. pipe discharging 106 gal. per min. 4. Riser pipe, splash table, discharging 64 g.p.m. 5. Spraco nozzle, discharging 72 g.p.m.

In all of the experiments herein described the rate of applied water, or "loading," was measured by taking meter readings at intervals of exactly 5, 10 or 15 minutes. A ⅝-in. Lambert meter used in the first experiments was replaced by a ¾-in. Trident and later by a 2-in. Crest as the flows increased. The CO_2 determinations were made in the usual manner by titration with N/22 sodium carbonate and phenolphthalein indicator. Titrations were made on the spot in intervals between meter readings.

Exp. 1: Multiple Coke Trays—The experience of certain deferrization plants in Germany and this country with beds or towers of crushed stone and coke suggested the possibility of good CO_2 removal with relatively high loadings of applied water, when using the device unsubmerged. The character of material used for such "scrubbers," whether stone or coke, was not considered

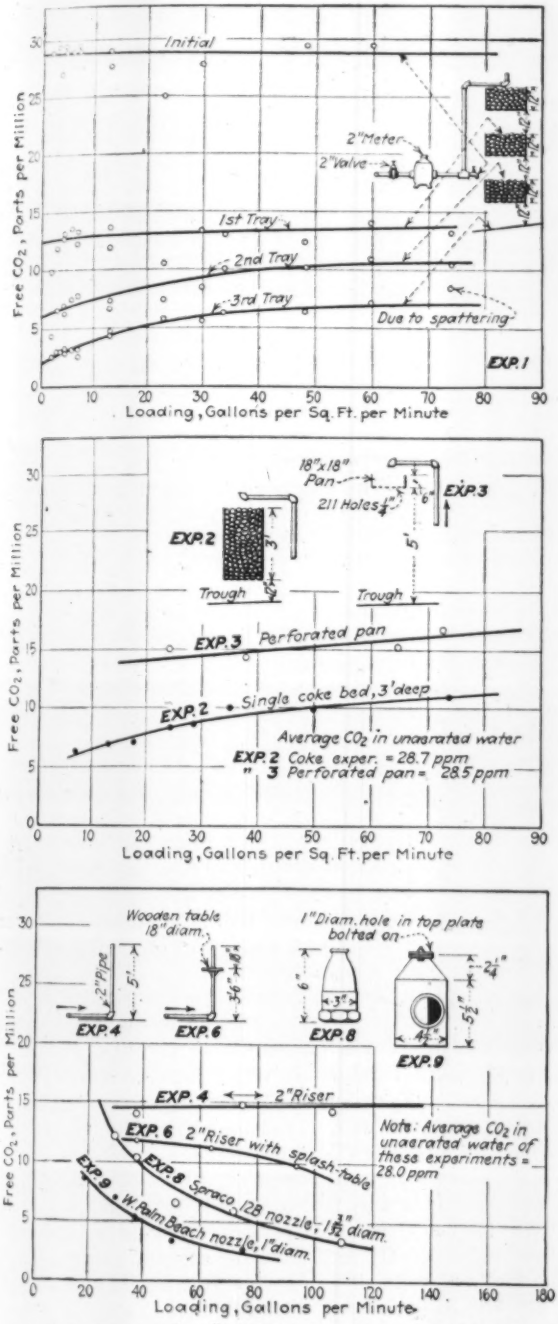


FIG. 6—EXPERIMENTS IN WATER DECARBONATION

essential provided the material was inert to the water. Limestone, dolomite, marble, etc., were barred on account of their solubility in the presence of free CO_2, which would result in an undesirable increase in temporary hardness of the aerated water. Coke, on account of its inert properties, light weight and availability, was selected for the Memphis experiments. At the outset it was thought that an arrangement allowing free access of air and free egress for the liberated gases would be more efficient than a single tower open only at top and bottom. Accordingly the apparatus pictured in Fig. 1 was set up, after the manner of the Shelby, Ohio, design, described by Burgess (*Jour. Am. W. W. Assoc.*, 1921, p. 193). It consisted of three superimposed trays, each 20x20 in. in plan by 12 in. deep. The trays were supported 12 in. apart, the bottom tray being 12 in. above the floor, which was a shallow wooden trough covered with composition roofing to collect the water. The bottom of each tray was covered with ½-in. mesh wire or hardware cloth to support the crushed material, which consisted of clean cupola or coke-oven coke, broken to sizes between 1½ in. and 3 in. The metered water supply was delivered at the top of the trays through an upturned elbow, short nipple and increaser, giving a slight spouting effect. For the higher flows it was necessary to place a pan over the discharge to eliminate spouting and the aerating effect of the jet itself. The experimental results are shown in graphical form by the curve entitled Exp. 1, where each plotted point represents the average of not less than two consistent observations.

It is evident that the first tray has done better than 50 per cent of the work, but each additional tray has served to materially bring down the CO_2 content. The flatness of the curves with increased loadings is noteworthy.

Exp. 2: Single Coke Bed—To determine the comparative merits of multiple coke trays and of a single deep coke bed the trays used in Exp. 1 were stacked one above the other without disturbing the contents, thus making a coke bed 3 ft. deep, open top and bottom. The results shown by the curve, Exp. 2, indicate that the 3-ft. solid bed had an efficiency equal only to the first two trays of Exp. 1.

Exp. 3: Perforated Pan—This apparatus, pictured in Fig. 2, consisted of a square galvanized-iron pan 18x18 in. in plan by 6 in. deep with 211 holes ¼ in. in diameter punched in the bottom, the pan being supported 5 ft. above the trough or floor. Results shown as by the curve, Exp. 3, indicate an efficiency of about 45 per cent for this device, with little variation with different loadings.

Exp. 4: Simple Riser Pipe—This experiment employed a vertical 2-in. riser pipe with the top 5 ft. above the floor, as pictured in Fig. 3. The results plotted as Exp. 4 are quite similar to those of Exp. 3 using the perforated tray.

Exp. 5: Inspirator Effect—The same arrangement was used as in Exp. 4 except that the outer shell of a conical nozzle was clamped in position over the top of the riser pipe, causing air to be drawn in and mixed with the jet, on the principle of the ejector pump. In operation the entrained air could be easily observed as pistons traveling with the jet, causing a decided scattering at the crest. This set-up showed an increased efficiency of about 12 per cent over the plain riser with the same amount of water flowing. Doubtless a well designed nozzle, instead of an improvisation, using the inspirator principle could be made quite effective.

Exp. 6: Riser With Splash-Table—This set-up was the same as Exp. 4 except that an 18-in. circular wooden platform was affixed to the riser pipe at a distance of 18 in. below the top, thus providing an intermediate step for the water in its fall as pictured in Fig. 4. From the curve marked Exp. 6 it is evident that the use of a platform or splash-board increases materially the efficiency of the riser pipe. Following the same reasoning it is to be expected that additional steps or platforms would result in still better efficiency, although

experiments were not continued to determine further effects.

Exp. 7: Riffle Board—The exposure of water by allowing it to run over an inclined surface in a thin film should allow ready aeration and escape of CO_2. A large aerator of this type was built over one of the settling basins some years ago at Suffolk, Va., for the purpose of reducing CO_2 in a lake supply, but was found not to have a very high efficiency. An elaboration of the "riffle board" idea is found in the plants at Newport, R. I., Chester, Pa., Norristown, Pa., New Brunswick, N. J., and several other places which utilize a sloped surface studded with cast-iron deflectors. All of these supplies handle surface water however.

At Memphis there happened to be handy at the Central Ave. station an inclined concrete walkway or approach 10 ft. wide by 28 ft. long with a drop of about 2 ft. in the length. The well water was applied as evenly as possible to the top of the incline and allowed to flow down the concrete surface which was grooved transversely. The results were as follows: Initial CO_2, 28 p.p.m.; aerated CO_2, 15 p.p.m.; efficiency, 46 per cent.

Exp. 8: Spray Nozzle—A "Spraco" No. 12-B nozzle was arranged to deliver vertically as pictured in Fig. 5. Results are shown as curve Exp. 8. Nozzles of this general type, employing internal deflecting vanes, are used in a number of water-works, but chiefly for odor and taste removal, as on the Catskill water supply, New York City, and at Lynchburg, Va. At Virginia Beach, Va., they are used on ground water for aeration and decarbonation.

Exp. 9: West Palm Beach Nozzle—The nozzle used in Exp. 9 differs from the Spraco nozzle in not having internal deflecting vanes. The spray effect is produced by the water entering the nozzle in a tangential direction at the periphery of the cylindrical shell. Nozzles of this type are in use at the iron-removal plants at West Palm Beach, Fla., and Long Beach, N. Y. Results are shown by the curve, Exp. 9. In comparing these results with those of Exp. 8, account must be taken of the difference in diameters of nozzle openings.

Exp. 10—At the conclusion of the Central Ave. experiments with the air-lift water the triple coke tray apparatus used in Exp. 1 was set up at the Auction Ave. station, without disturbing the contents. In doing this it was desired to note the performance of the coke scrubber when handling water of high carbonic acid content.

Accomplishments of the three-tray scrubber on water of 101 p.p.m. CO_2 content, when handling 50 gal. per square foot per minute, were found about the same as that of typical air-lifts. In other words, it would take an additional three trays to reduce the CO_2 to the figure obtained by the Central Ave. experiments, using the same apparatus.

Conclusions—The writer's conclusions from the foregoing experiments are summarized as follows:

1. The spray nozzle was found most effective of several devices used for removing CO_2 from water by aeration. Objections to the spray nozzle are (a) the area and head required; (b) the opportunities of contamination of open spray ponds of considerable area by dust and soot; (c) probable nuisance to adjoining property from wind carriage of spray, even where substantial louvres are provided.

2. From the standpoint of heavy loading, with minimum floor space and head utilized, the multiple coke-scrubber is believed to have merits over the other devices tested. The efficiency in carbonic acid removal is not equal to the spray nozzle, but is sufficient for practical purposes in dealing with moderate content. The superior efficiency of the coke scrubbers compared with other splashing devices, such as perforated pans or riser pipes, utilizing the same head, is apparently due to air being drawn with the water through the coke and thus assisting materially in sweeping out the CO_2 gas.

3. Even distribution of water over a coke scrubber is very important. Short circuiting along the inside walls of the trays, or by outside spattering, interferes materially with efficiency and should be carefully provided against.

4. The coke scrubber may be used on waters of high carbonic acid content by adding other trays to the stack and increasing the head requirements accordingly, but if the total head requirement exceeds 12 to 15 ft. the spray nozzle may be the better solution.

5. With a CO_2 content of 100 p.p.m. or over it is doubtful if any scrubbing or splashing device can compete successfully with a good type of spray nozzle, on the basis of equal head utilized, though other considerations mentioned may govern.

Design Adopted for Memphis—The aerating equipment for the new 18-m.g.d. purification works now actively under construction at Memphis will be of the multiple-tray coke scrubber type. There will be 40 units about 2 x 7 ft. in plan, made up of four superimposed trays of coke 10 in. deep, spaced 9 in. vertically. The arrangement of units and trays will allow free circulation of air. Uniform distribution of water to the top tray will be by a trough having a perforated bottom. A loading of 30 gal. per square foot per minute was used in the design.

Road Crossing Accidents on Pennsylvania R.R.

That 97 per cent of automobile drivers are reasonably careful and that the deaths and injuries which occur on streets and highways and particularly at railroad crossings are due to gross or criminal carelessness of the other 3 per cent is the conclusion presented in a report by the insurance department of the Pennsylvania R.R. system, this report being based on checks of more than 100,000 drivers at crossings during a period of four months. Of 682 crossing accidents during that period, 607 were due to motor vehicles, five to street-cars and 31 to horse-drawn vehicles. Further, 487 of the accidents occurred in broad daylight and 195 at night, while about 50 per cent involved passenger trains and 50 per cent freight trains and switch engineers. Of all these trains about 60 per cent were running at speeds lower than 20 m.p.h. Some of the figures of the report are summarized in the accompanying table:

	No. of Accident	Deaths	Injuries
Automobiles	428	59	94
Motor trucks	175	12	37
Buses	4	...	...
Attempt to cross ahead of train	...	7	17
Disregard of crossing bell	...	14	7
Disregard of watchman	49	5	22
Due to defective automobile brakes	16	...	...
Intoxicated drivers	7	3	3
Automobiles stalled on tracks	61	6	12
Automobiles running through gates	280	...	...
Automobiles running into side of train	70	14	22

Railway Water Treatment Plants and Their Operation

Successful Results Depend on Proportioning of Chemicals to Suit Character of Water and Its Frequent Changes

By Fred D. Yeaton
Assistant Engineer of Water Service, C., M. & St. P. Ry.

In the treatment of water for locomotive boiler supply the proper quality of chemicals and the proportioning of the solutions to suit different waters are apt to be overlooked, since the plant attendants are largely pump men and the engineers having supervision of the plants often have little chemical knowledge. Simple tests and care in operation are necessary for efficient service and such service can be secured if the work is in charge of an experienced water-service engineer. Greater attention is now being given to railway water supply, since increased capacities and higher steam-pressures of modern locomotives have resulted in demands for increased supply and better quality of water. Furthermore, it is being more widely recognized that the quality of water has an important bearing on the operating service and repair cost of the locomotives.

Under these conditions increasing responsibility is being placed upon the railway engineers in the selection of suitable treatment for the varying character of water encountered and especially in having this treatment carried out properly by the non-technical men charged with the operation of water supply and treatment plants.

In railway water service the principal chemicals employed are lime and soda ash for softening hard water, and sulphate of alumina and sulphate of iron as coagulants for turbid water. Some other chemicals are available for water softening, but lime and soda ash have the advantage of combining efficiency with low cost. All chemicals should be purchased under careful specifications as to quality and with due regard to requirements for proportioning.

Lime—Both quicklime and slaked or hydrated lime are used, but the latter seems to be coming into more general use, as it does not require to be slaked at the treating plant and does not deteriorate by storage for about a year. Quicklime slakes by absorbing moisture from the air and at the same time it absorbs carbonic acid which renders the lime useless for water softening. Lime made from magnesium calcium limestone should not be used, as the magnesium is of no value in treating water and only increases the amount of sludge to be handled.

In water softening, the lime is used to remove the carbonic acid and cause precipitation of the hard scale-making carbonates. It is applied as milk of lime, containing about one part of lime to ten parts of water, by weight.

Soda Ash—This material is divided commercially into "light" and "dense," only the former of which should be used in water treatment. Its purpose is to replace the scale-making limestone sulphates by non-scaling sodium sulphate. Soda ash is the basis of most of the anti-scale boiler compounds which are used by many railways. For this use it is either added to the water in the tender or placed directly in the boiler through the washout holes after the boiler has been cleaned.

Sulphate of Alumina—This material (often erroneously termed "alum") is a very effective coagulant for highly turbid waters from reservoirs and streams. It dissolves very readily in hot water, a precipitate being formed which must be allowed to settle before the solution is used. The best sulphate of alumina contains about 17 per cent of water-soluble aluminum oxide, which should be 3 per cent or more in excess of the amount theoretically required to combine with the sulphuric acid in the water.

Sulphate of Iron—This ferrous sulphate when used in conjunction with lime is a good coagulant for turbid alkaline waters, such as those of the Missouri basin. The best form, known as "sugar of iron," is partly dehydrated. Several railroads have used ferrous sulphate successfully for removal of the last three grains of calcium carbonate from boiler waters in order to eliminate clogging of the injectors and branch pipes of the locomotives.

Proportioning Water Treatment Solutions—The amounts of lime and soda ash for water softening should be determined and added accurately according to the scale-producing elements which are to be removed. Well waters do not vary much in hardness from day to day, but waters from lakes, reservoirs and streams may change in character frequently. For instance, the water of several rivers of South Dakota often varies in 24 hours by as much as 10 to 20 grains of encrusting solids per gallon.

Treated water tested recently showed 14 grains hard and it was found that a sample of the raw water had been sent to a chemist several hundred miles away. The instructions as to treatment were being followed, but in the meantime the character of the water had changed materially.

Close control of the operation of a treating plant is necessary for successful results. Failure of many such plants may be traced to loose and careless methods. Not only does the raw water change, as noted above, but devices for proportioning chemicals get out of order and the quality of chemicals also varies considerably. These variations can be detected only by careful supervision of each plant.

The amounts of lime and soda ash required for any given water may be obtained in several ways. The method of water analysis given usually in text books involves too much time and care for regular use at the treating plant or by traveling inspectors employed by the railway.

A small and cheap but effective field testing outfit may be made, containing standard soap and acid solutions, methyl orange and phenolphthalein indicator solutions, and sufficient limewater for trial treatments. There will be also several small droppers, bottles, filter paper, funnel and 5 and 60-cc. graduates. The necessary knowledge of chemistry, the methods of operation for the use of such an outfit and the treating methods to be followed from these results can be taught to any fairly intelligent pump retainer or pump man. But the treatment to be used on an engine division or for any particular water requires considerable experience with water treatment and locomotive service. It can best be directed by someone who has had experience as a water-service engineer.

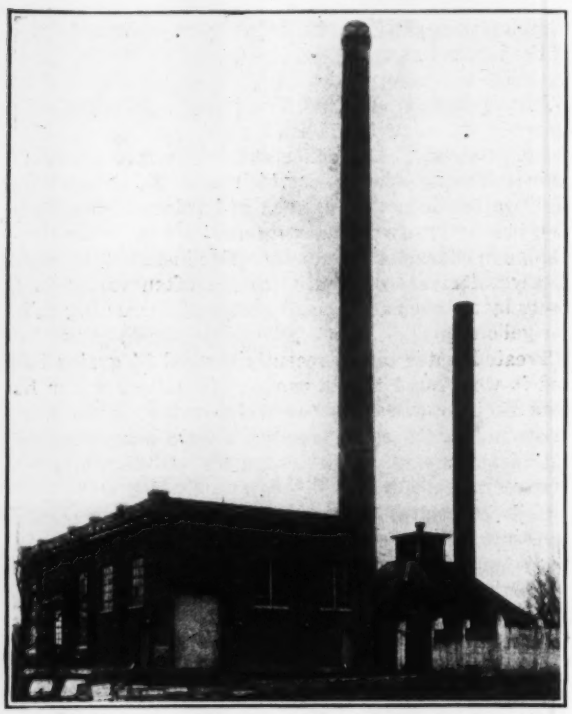
Overhauling Outgrown Water-Works at Fort Smith, Ark.

Gas-Burning Boilers Put on High Efficiency Basis—Centrifugal Pumps Chosen on Previous Eight Years Experience

BY WYNKOOP KIERSTED, JR.

Assistant Engineer, Kiersted & Stringfellow, Consulting Engineers, Kansas City, Mo.

EXTENSIONS to the overtaxed water-works plant at Fort Smith, Ark., include four new filters, boilers, a chimney, high- and low-lift pumps, dry chemical feeders and a general overhauling of the old pumping machinery. Before the improvements great difficulty was experienced in keeping the city supplied with water of even inferior quality. The four 1-m.g.d. filters were overworked; coagulant was crudely applied through neglect of proper upkeep; the pumping machinery was overtaxed and greatly deteriorated and the 25-year-old plain-tube boilers were extravagantly fired.



FORT SMITH WATER-WORKS PUMPING STATION
Old boiler house and steel stack in rear at right are to be removed. New boiler house is extension of old pump house at left.

Boilers—Two 300-hp. water-tube boilers with forged steel sectional headers proportioned for 200 lb. pressure were selected as the best and cheapest for this installation. Provision was made for superheaters later on. Gas burners designed for natural gas were installed in the fire doors of the boiler fronts and the space below the level of the burners filled with sand paved with firebrick. A combustion space of 1 cu.ft. per boiler horsepower was thus allowed. Later if it becomes necessary to operate the boilers at a higher rate the burners may be placed in the ash-pit doors and the sand removed to afford greater combustion space.

As aids to economy and certainty of operation an open-type feed-water heater and two boiler-feed pumps of the simplex, direct-acting type were installed. The 8-in. front and 6-in. rear steam headers are equipped with extra heavy steel valves, flanges and fittings while the piping is extra heavy with lap joints. All live-steam pipes, boiler heads and feed-water heaters are covered with double standard thickness magnesia covering and the feed-water and auxiliary exhaust pipes with single thickness of magnesia.

The new 150-ft. reinforced-concrete chimney has a top inside diameter of 5 ft. and is built on a foundation extending to rock about 26 ft. below the surface. The proportions are sufficient to permit a future change to coal as a fuel.

In line with the class of workmanship required and materials employed to obtain a high degree of steam boiler efficiency, openings in the setting were carefully filled and thermometers, draft gages and draft regulators were provided for fire control. Flue-gas analyses are made at the plant periodically and under operating conditions show the CO_2 as 80 per cent of theoretical perfect combustion of natural gas, free oxygen 2 per cent and carbon monoxide not present. This high boiler efficiency is facilitated by the constant load.

Pumping Installation—In the existing plant were a duplex direct-acting triple-expansion high-lift unit and two turbine-driven centrifugal low-lift pumps, each of 5-m.g.d. capacity.

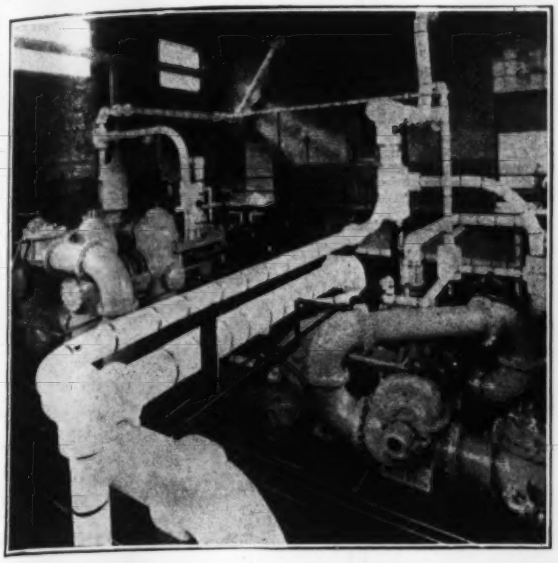
Before preparing specifications for the turbine-driven centrifugal pumping units informal proposals were obtained on a cross-compound rotative pumping engine of the opposed type and a direct-acting triple-expansion unit. The great cost of the former type of engine and the misfit in the available space, eliminated it from further consideration. The triple-expansion direct-acting unit was not accepted on account of serious objections to that type of engine which developed during the eight years use of the existing unit. The most serious of those objections are as follows: High cost of condenser, air pump and valve repairs, and renewals; large oil consumption; presence of oil in the condensate; overreach of plunger and occasional heavy hammer when the pumps are delivering water into the distribution system with surplus pumpage going to the distribution reservoir; station duty running considerably below the original test duty of 98 million; audible pump pulsations communicated to residences through the plumbing, and pounding of check valves on the reservoir lines of pipe.

These objections were further supported by the fact that the direct-triple unit would cost about 28 per cent more than the turbine-centrifugal unit and would be a misfit in the available space. Moreover, evidence showed that the station economy of the turbine unit would exceed that of the triple unit and that it would fit the available space with room to spare.

Eight years of satisfactory use of the two turbine-driven centrifugal units for low-lift work and the restricted available space of 15 ft. square necessarily confined consideration to this particular type of unit for low-lift work.

Results thus far seem to confirm previous conclusions. In the new installation the turbines of both the high-lift and the low-lift units exhaust into the same condenser. The test duty of the low-lift unit was 97,000,000 ft.-lb., exclusive of auxiliaries, and of the high-lift unit 110,000,000 ft.-lb. per 1,000 lb. of steam including auxiliaries.

During the month of February, 1922, when the two



NEW 8-M.G.D. HIGH LIFT IN FOREGROUND AND OLD TRIPLE EXPANSION UNIT BEYOND
Water end of both units painted light color. All steam lines heavily covered to prevent heat losses.

new units were in operation constantly, the fuel cost (natural gas) was $809—equal to a fuel cost of $8.24 per m.g. of water output. In March the new machinery was shut down for painting. During that month the old pumps scored a station fuel cost of $1,052 and a water output cost of $10.80 per m.g. In both months the high-lift water pressure was 80 lb. and the low-lift in February about 50 ft. but 4 or 5 ft. less in March. Both turbine units during February worked at 55 to 60 per cent of their rated capacity, while the triple unit and the old turbine units worked at 70 to 80 per cent of rating.

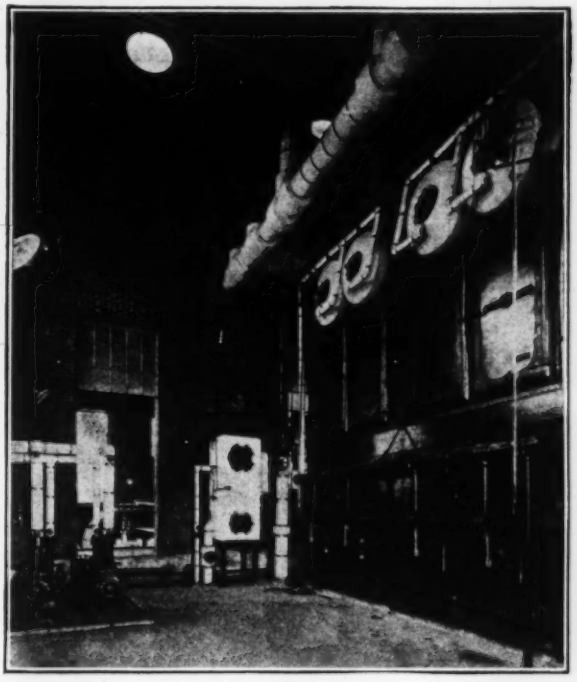
The high-lift pumping unit consists of a Terry turbine geared to two Lea-Courtenay pumps in series. The low-lift unit is of the same make and design except that there is but one pump. The Beeson Machinery Co., of Kansas City, Mo., was the contractor for the machinery installation.

The double-stage steam-ejector principle of maintaining a vacuum of 29 to 29.5 in. of mercury in the condenser has been particularly satisfactory. Likewise a single steam jet has successfully primed the condenser and pumps as well as relieved the river suction and river pumps of air. Heretofore air in the river suction at low water of the river, when the combined static and friction lift was 17 ft., caused considerable annoyance. The discharge from both the two-stage jet and the suction jet goes into a hot well outside the building.

Coagulation—A bronze motor-driven centrifugal pump supplies a constant head (6-in.) orifice box for the alum feed. The quantity of solution remains the same but the strength of solution is varied to suit the changing turbidity and pumpage.

A dry lime-feed machine is located over a mixing chamber 10 x 12 ft. in plan and 10 ft. deep, divided by a vertical baffle into two compartments. One compartment receives water from the river pumps while the other discharges through a pipe in the bottom into the adjoining settling basin. The dry lime drops into a water-flushed hopper and thence is conducted through 8 ft. of 2½-in. pipe to the opening of the influent pipe. The water in weiring over the vertical baffle receives the alum solution. The mixing of the coagulants with the raw water is effected by the weir drop and water swirl in passing through the chamber.

The alkalinity of the Poteau River water varies from a little over 20 during freshets to 80 or 90 p.p.m. at low water. The hydrogen-ion concentration in a few tests varied from a pH value of 5.8 to 7.0. In this condition a turbidity of 600 to 2,000 p.p.m. is readily flocked and



NEW BOILERS SHOWING GAS BURNER INSTALLATION

reduced to such a condition by filtration that small objects can be seen in the bottom of the clear-water well through 25 ft. or more of water.

This condition does not prevail indefinitely. Backwater from the Arkansas River, sometimes containing alkali and always of high turbidity, introduces complications which speedily disorganize the ordinary procedure of coagulation and modify results materially. Even the Poteau River water unaffected by Arkansas River backflow responds to the coagulation process.

Wynkoop Kiersted, consulting engineer, Kansas City, Mo., planned and supervised the construction of the extensions to the Fort Smith water-works in 1913 as well as those described. The author acted as resident engineer during the recent construction and during the installation and testing of the pumping machinery. The cost of the extensions was $177,000—$23,000 less than the estimate.

F. A. E. S. Urges Reforestation

The Reforestation Committee of the F. A. E. S. is promoting a nation-wide effort to unite all agencies for elimination of waste within the industry, for reduction of waste of basic materials, and for conservation of and reforestation for future supply. "The virgin forests of the United States have been reduced to 40 per cent of the original," according to Executive Secretary L. W. Wallace, "and the time is rapidly approaching when the supply of merchantable timber will play an important role in the economic and social aspects of the nation."

From Job and Office

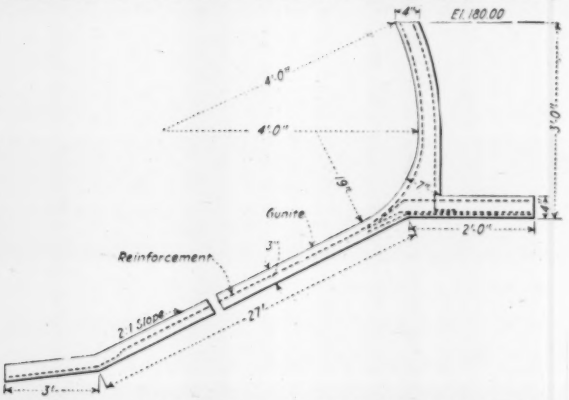
Hints That Cut Cost and Time For the Contractor and the Engineer

Reservoir Embankment Protected by Gunite Reinforced Slab

By A. S. Holway
Chief Engineer, Water Department, Oklahoma City, Okla.

In 1919 Oklahoma City completed a new 5,000,000,000-gal. water-supply reservoir in the bed of the North Canadian River. The water was turned in through the feed gates, but was never allowed to reach the crest of the spillway because the banks of the reservoir, which are made up of a very light silty soil, were being washed away so rapidly by the waves that it was necessary to lower the water level at once to save the reservoir.

Because of the large amount of silt carried during floods, the river was bypassed around the reservoir by means of a canal separated from the reservoir by an embankment with an 18-ft. crown. Originally the slope



COMBINED WALL AND SLAB FOR SLOPE PROTECTION

on the bypass side was 1 on 2½ and on the reservoir side 1 on 5. A portion of this embankment was one of the sections which was most rapidly attacked by the waves. The other section endangered by the action of the water was the south shore of the lake for a distance of approximately 6,000 ft. west of the main dam where the shore line was particularly vulnerable because it is paralleled by a drainage ditch lower than the reservoir water level.

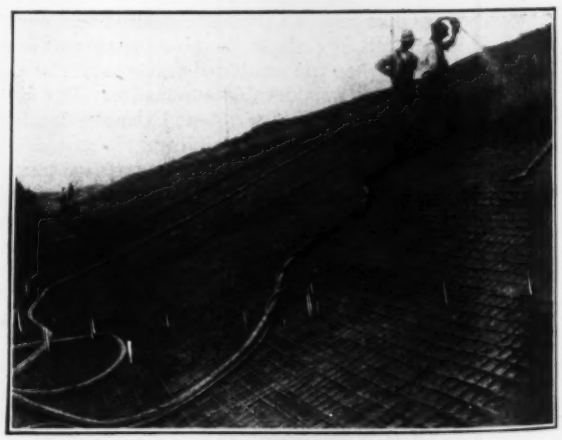
Following a comprehensive study, it was decided that a combined wall and slab of reinforced gunite would most nearly meet all the requirements.

As constructed, the protection work consists of a 3-in. slab on a 1 to 2 slope, 27 ft., measured along the slope, surmounted by a 3-ft. cantilever wall with a curved face. The slab is extended 3 ft. on the bottom on a 1 to 10 slope. A heel 4 in. thick extends behind the wall from the point where the wall and slab join. Normally the water level will vary from 7 to 12 ft. below the top of the wall. The slab is reinforced with electrically-welded steel wire fabric consisting of No. 4½ wires, 4 in. c. to c. each way. This gives a sectional area of 0.11 sq.in. in each direction. Expansion butt joints filled with a bituminous filler are located 100 ft. apart. Directly

RESULT OF WAVE ACTION ON BYPASS EMBANKMENT

under the joints a slab 30 in. wide was placed and separated from the main slab with tar paper. The specifications called for a 1:3 cement and sand mixture, with the voids in the sand varying from 30 to 35 per cent. As the protection is 10,800 ft. in length and the amount of work at any one point was extremely small, the contractor adopted a plant layout to meet these conditions, consisting of five compressors, driven by 2,300-volt motors. Two cement guns were used on the wall and three on the slab.

The slab was shot directly on the carefully graded slope after the ground was thoroughly wet. Great care was taken to lift the wire reinforcement up into the gunite as it was placed. Numerous test sections cut from the finished slab showed invariably that the reinforcement is almost exactly in the center of the slab.



SHOOTING THE 4-IN. SLAB AGAINST MOIST EARTH SLOPE
Reinforcement was raised to center of slab. Air was piped from central plant maximum of 3,000 ft.

Both wood and steel forms were used for the wall but the wood proved to be more satisfactory. After 24 hours the forms were removed. The method of shooting into the forms concentrated the sand pockets on the face of the wall. These pockets were all dug out with picks and chisels and the wall was then flashed with approximately ¼ in. of gunite.

The quantities involved and the prices bid were as follows: 45,000 cu.yd. of excavation at 45c.; 33,000 sq.yd. of trimming at 10c.; 297,000 sq.ft. of slab at 37.1c.; 10,850 ft. of top wall at $4. Work was started in June, 1922, and completed in October.

The Pratt Thompson Construction Co. of Kansas City, Mo., was the contractor for the work, which was designed and constructed under the supervision of the writer, with C. E. Bretz as assistant engineer.

Laying 48-Inch Water Main in Detroit

DOWNTOWN pipe-laying in Detroit is carried on expeditiously by use of a trenching machine for the excavation, rarely more than three or four blocks being opened at a time. In the picture herewith is shown, in Elizabeth St., a portion of a 5-mile, 48-in. feeder from the pumping station tc Sixth St. Except for 2,200 ft. of hammer-weld pipe with bump riveted joints the line is lock-bar pipe. As this particular section was yellow clay the 10-ft. trench stood up well, but at crossings under street car tracks it was carried in three-ring brick culverts with concrete inverts.

PIPE LAYING OPERATIONS CONFINED TO THREE BLOCKS

Following pavement breaking is a trench machine making a trench 10 ft. deep for 48-in. main, practically filling street with earth. Actual laying follows trenching machine closely in same block.

As fast as existing lead services were severed by the trenching machine, they were connected up with rubber hose and left in that condition until backfilling was under way, when they were replaced with lead pipe. Where telephone conduits interfered, the cables were cut, new cables spliced in and looped over the pipe. Manholes were then built over the pipe at these points.

Field joints were left uncovered until the pipe had been subjected to 100-lb. test pressure. All leaks were then carefully calked and the joints coated with a special paint before backfilling.

This pipeline extension was laid by the Gillespie Contracting Co. under the general direction of George H. Fenkell, superintendent and general manager, Detroit Department of Water Supply.

"A Cold Weather Fight and Warm Weather Sedative": a Scenario

BY LOUIS L. TRIBUS
Tribus & Massa, Engineers, New York City

PLACE: *Within 1,000 miles of New York City.*
SEASON: *Late winter.*
TEMPERATURE: *Zero, or lower.*
WATER SUPPLY: *Gravity.*
AGE OF SYSTEM: *Between 25 and 30 years.*
DRAMATIS PERSONAE: *Chairman of a Water Board, Anxious Citizens and a Consulting Engineer.*

SNUGLY settled by the fireside on a cold winter's evening, reading (the *Engineering News-Record*, of course), the consulting engineer is jarred from his comfort by the persistent tinkle of the telephone bell. At the other long-distance end a much perturbed official voice tells of a most distressing condition of affairs; a town largely out of water, and *no apparent cause;* the consulting engineer is wanted at once to relieve the distress. (Note the confidence in an engineer.)

There is no train until morning, but early in its chill air the engineer is on his way. At conference on arrival, information is given that for days previous shortage was increasingly felt, yet a careful inspection of the long gravity pipe line had not shown any leak; the impounding reservoir was full, therefore something serious must have happened to the intake, or some choking on the line.

The engineer asks as many, or more, questions as a six-year-old, and inspects everything that can be seen; also telephones for a diver.

With the engineer's arrival the temperature begins to moderate, and water begins to reach higher levels.

The diver arrives. He finds the conical intake screens partly choked, and wedged tight, from many years of neglect. He removes a couple of buckets full of sediment and rust, relieving the strong suction created by the water drawn through the limited screen area, and puts the screen once more into fair working order. The water carries but little sediment, so that screens are more for fish elimination than for filtering.

As the weather moderates greatly, the water in the town rises again to the high levels, and the clearing of the screen is given the credit.

* * *

AS WATER-WORKS' readers will surmise, the real facts of the case were that draft to prevent freezing of plumbing, on the lower levels, used up all the pipeline capacity, so that little was left for the higher levels.

The engineer having, as outlined, relieved the pressing situation, with aid of Old Sol and South winds, con-

tinued to make full flowage and use studies, fully verifying his surmise.

The main pipe line had been planned nearly 30 years before to serve a purely residential population, and had capacity for reasonable increase. The population growth had not quite materialized, but special and unexpected commercial needs had developed.

Facilities had not been adequately provided for getting the full value of an equalized 24-hr. flow, which naturally the engineer recommended, as well as certain other changes in the way of betterment. In the event of similar temperature conditions, even with equalized supply, the likelihood is still imminent of cold weather shortage, and the writer so reported to the town, but they have as yet taken no steps to protect themselves.

Designing Filtration Plants Graphically

BY P. B. STREANDER
Chief Engineer, Roberts Filter Manufacturing Co., Darby, Pa.

IN DESIGNING a water filtration plant, certain units or parts are common to all plants such as subsidence or coagulating basins, filter units, sand strainers, laterals, wash troughs, piping, sterilization, pumping, etc., the proper determination or proportioning of which takes considerable time. Among the charts devised to reduce this time, none is so rapidly constructed nor so easily read as the charts of the alignment or nomographic type, examples of which as utilized by the writer are given below. These charts are based on the use of three or more logarithmic scales, parallel or inclined, depending on the form of equation used.

Wash Troughs—The spacing of wash-water troughs should be such that the farthest horizontal travel of the water will not exceed 3½ ft. as a maximum. The size of the wash trough is of considerable moment for if this is made too small, it will be impossible to wash the filter bed properly. An approximate formula for calculating the discharge capacity of wash-water troughs has been derived by C. N. Miller and is explained more fully in the appendix of J. W. Ellm's book on "Water Purification." This formula has been used by the writer with very good results and is as follows, using the notations of

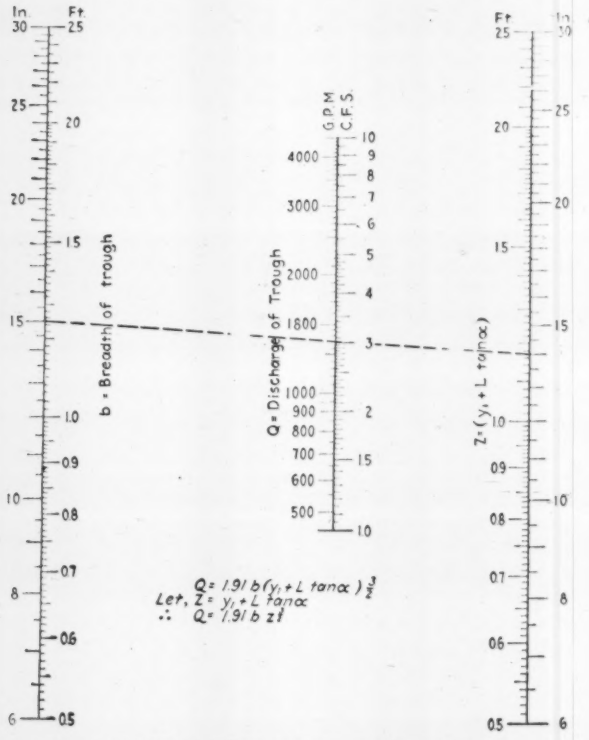


FIG. 1—SQUARE WASH-WATER TROUGH CAPACITIES
Having the total discharge capacity of the trough in gallons per minute or cubic feet per second on scale 3, project from this point to breadth of trough assumed on scale 1 and obtain the value of Z on scale 2. The dimensions of B and Z are for rectangular shape troughs. For shapes of troughs not rectangular application of the above chart can be made by assuming a rectangular section of equivalent area. The value of Y_2 or the depth of water at the discharge end of the trough applies to a case where the discharge is into a chamber in which the water level is at or near the level of the water in the lower end of the trough. In case of free fall the actual value will be less owing to the weir action.

Q = Total quantity of water received in trough in cubic feet per second.
B = Width of trough.
Y_1 = Depth at shallow end of trough.
Y_2 = Depth at discharge end of trough = $\frac{2}{3}Z$.
L = Length of trough.
A = Slope of bottom of trough.
$Q = 1.91\ B(Y_1 + L \text{ tang. } A)^{\frac{3}{2}}$ and letting
$Z = (Y_1 + L \text{ tang. } A)$
then
$$Q = 1.91\ BZ^{\frac{3}{2}}$$

Fig. 1 gives this formula in chart form.

From Job and Office

Hints that Cut Cost and Time

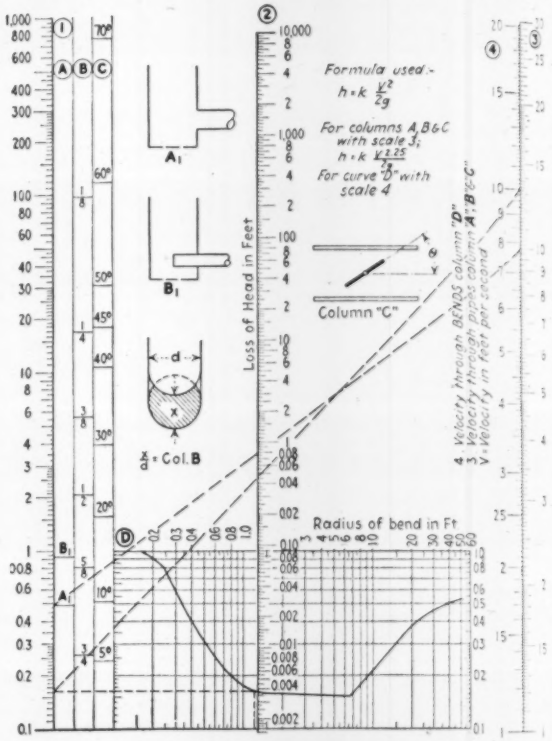

Formula used:-
h = k V²/2g
For columns A, B & C with scale 3; h = k V^1.25/2g
For curve "D" with scale 4
Column "C"
Loss of Head in Feet
Radius of bend in Ft
4 Velocity through B&NOS column "D"
3 Velocity through pipes column "A" B & C
V = Velocity in feet per second
x/d = Col. B

FIG. 2—LOSS OF HEAD AT ENTRY, BENDS AND VALVES
To obtain entry loss of head, connect the velocity through the pipe scale 3 with the constant K (depending on type opening) projected to scale 1 and read the loss of head on scale 2. To obtain the loss through bends, first determine the value of constant K by projecting the vertical line corresponding to the radius of the bend until it intersects with the curve shown. From this point project horizontally to the left to scale 1 and connect this point with the velocity through the bend on scale 4 obtaining the loss on scale 2. For losses through partially closed valves determine the fractional opening of the valve and on column B project to scale 1 and proceed as before. For partially closed butterfly valves proceed same as for gate valves.

From Job and Office

For Contractor and Engineer

Pipe Losses—Fig. 2 gives losses due to bends in pipe, entry loss and loss through valves, etc. On this chart all losses have been computed in terms of $H = K\frac{V^2}{2G}$ where K is a constant depending on the construction of the pipe entrance indicated in column A for entry head loss, on how much a valve is closed in column B (not ordinarily used) and the degrees which a butterfly valve in column C is closed (used only where this loss is required as on the butterfly valve to subsidence basin) and upon the radius of the pipe column D for losses through bends. The loss through bends has been based on the formula $H = \frac{V^{2.25}}{2G}$ prepared by W. E. Fuller (*Journal* New England Water Works Association, December, 1913). It is more convenient to handle than the Weisbach formula.

Pumping Equipment—The pumping equipment in most modern filtration plants is usually of the high-speed centrifugal type having as prime movers, electric motors or steam turbines. Fig. 3 is an alignment chart for quickly obtaining the horsepower required for quantities ranging from 40 to 10,000 gal. per minute and heads of from 1 to 1,000 ft. Alongside of the gallons-per-minute column are listed the sizes of pumps required for capacities shown. The maximum pump capacities are to be used if the total head exceeds 45 ft. and suction head not to exceed 15 ft. If the total head is less than 45 ft. use the smaller capacities.

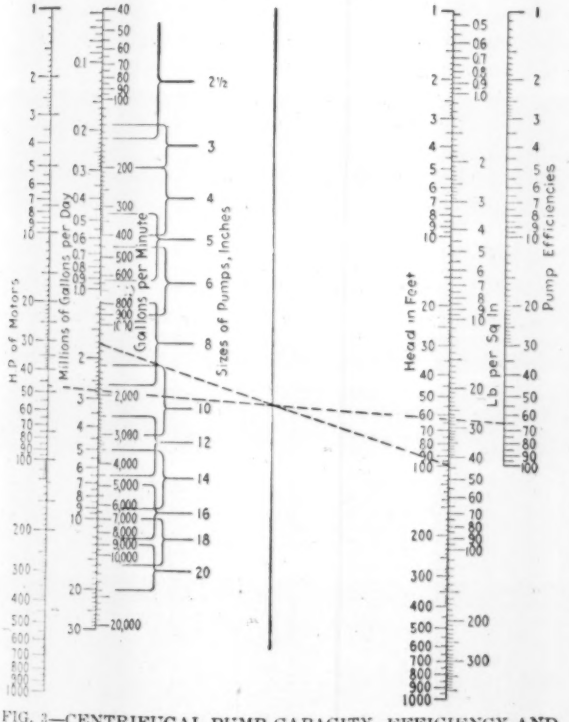


FIG. 3—CENTRIFUGAL PUMP CAPACITY, EFFICIENCY AND REQUIRED POWER

To use the chart having given the gallons per minute and heads, connect these two scales by a line through the reference line. From the intersection of this and the reference, connect with the pump efficiency and read the brake horsepower required on the horsepower scale.

Lubrication Saves $2,500 Replacement of Water-Main Valve

By Wm. W. Brush
Deputy Chief Engineer, Department of Water Supply, Gas and Electricity, New York City.

FRICTION is a great consumer of energy, and yet how frequently do we see failure to apply to both human beings and inanimate machines that which will lubricate contacts where friction exists, thus largely eliminating it. Valves on water mains, especially the larger ones, are expensive machines, but virtually no provision is made for their lubrication after installation. This condition leads to hard operating valves, requiring several men on a cross-bar, even within a year of their installation.

A case in point is a 48-in. valve on Fifth avenue at 29th St., New York City, on a main through which Croton water flows from about 8 p.m. to 5.30 a.m., the flow then being shut off until evening. This valve is operated twice daily by hand. In the late summer of 1922 it was reported that the valve must be replaced, as it could not be kept in good operating condition. To replace the valve was estimated to cost $2,500.

As the difficulty appeared to be excessive friction on the thrust bearing, an oil cup was installed and piped to this bearing to furnish it with a constant supply of oil. A continuous slow drip from the oil cup could not be secured during the cold weather, due to the congealing of the oil, and the stop cock on the oil cup was opened to allow freer flow. As a result, it was necessary to supply new oil frequently. The application of the oil in this manner caused the valve to operate easily.

A substitute for the oil cup, in the form of an oil pipe carried to a point just below the underside of the manhole cover, is to be installed, and a small amount of oil will be daily discharged into this pipe, thus lubricating the thrust bearing.

Aeration of Water Immediately After Alum Dose Saves Soda

By Malcolm Pirnie
of Hazen & Whipple, Civil Engineers, New York City

ABOUT two months ago the writer had an opportunity to study the treatment of the Dan River water at Danville, Va., with Richard Messer, chief engineer of the Virginia State Board of Health, and Lynn H. Enslow, sanitary engineer. The records of the filtration plant showed that soda was used with alum to get coagulation about nine months in the year, and this suggested that we might reduce the acidity of the water by aeration immediately after the alum dose.

We found upon experiment that the water would not coagulate within a reasonable time with any dose of alum from 1 to 10 gr. per gallon. With an alum dose of 1½ gr. and soda dose of 1.13 gr., a good immediate floc was obtained. This was also true for an alum dose of 2 gr. and soda dose of 1.5 grains. However, upon standing for several hours the coagulation was not so good as that first obtained and better coagulation was observed in the samples containing lower relative doses of soda.

A sample of water was therefore dosed with alum at the rate of 2 gr. per gallon and with soda at the rate of 0.8 gr. per gallon. Half of it was aerated immediately by pouring slowly from one beaker to another. The aeration caused the immediate formation of an excellent floc which was the equivalent of that obtained

when 1½ gr. per gallon of soda were used without aeration. With the aeration, however, there was no deterioration in the sample upon standing several hours. The unaerated portion of the sample dosed with 2 gr. of alum and 0.8 gr. of soda did not show a precipitate inside of two hours, but would precipitate upon standing overnight. The difference in these results was due to the difference in the amount of free CO_2 present in the water. Driving off the CO_2 by aeration made immediate coagulation possible with but half the amount of soda that was required to produce similar coagulation without aeration.

For the information of those who may be interested in the pH of the water, the following results are given:

	pH
Raw water	7.35
Sample dosed not aerated	6.60
Sample dosed and aerated	7.20

All samples that showed good coagulation whether immediate or after standing overnight had a pH between 7.1 and 7.2. Samples dosed with higher amounts of soda which gave an immediate good floc had a pH of 7.1 and later as the floc went partly back into a milky state the pH was found to be higher in the neighborhood of 7.4 to 7.5.

These experiments indicate that a considerable saving in the amount of soda required can be made by aeration immediately after the dose is applied.

A Departure in Water-Works Intakes

By C. M. Daily
Engineer-in-Charge Supply and Purifying Section, Division of Water-Works, St. Louis, Mo.

If the water commissioner of St. Louis, Mo., followed precedent in building an intake for the Missouri River plant, his selection would be a tower intake located in the main channel where the turmoil of water around the tower would be a prolific source of trouble from sand carried into the ports during high water and from ice during the periods of flowing ice in winter.

From Job and Office

Hints that Cut Cost and Time

When a sandbar is passing a tower, the sand does not roll along the bottom but is picked up by the swirls caused by the tower and carried past in suspension.

FIG. 1—DAMAGED SCREEN TOWER WATER INTAKE

the ports in use receiving their share of the sand and gravel which deposit along the tunnel leading to the wet well. The new tunnel has been cleaned twice since it was put in service in 1916, the sand averaging about 4 ft. in depth over its entire length each time it was cleaned. When floating ice strikes a tower the cakes are broken into small fragments which are carried by the mixing action of eddies into even the lower ports of the intake.

Undisputable proof of the eddies caused by tower intake is shown by Fig. 1, which is a view of a damaged screen taken from one of the ports of the new tower at Chain of Rocks last November, in which gravel and boulders weighing as much as one pound are lodged between the bars. This screen was in place four years and its bottom was 9 ft. above the river bed. The boulders were lifted by the swift eddies caused by the tower.

Experience with the two tower intakes in the Mississippi River at Chain of Rocks has led to the adoption of a shore intake (Fig. 2) for the Missouri River plant where the current of the river will be directed and maintained by suitable dike work and where the water will pass smoothly, free from eddies or swirls. It is expected that there will be but little trouble from either sand or flowing ice.

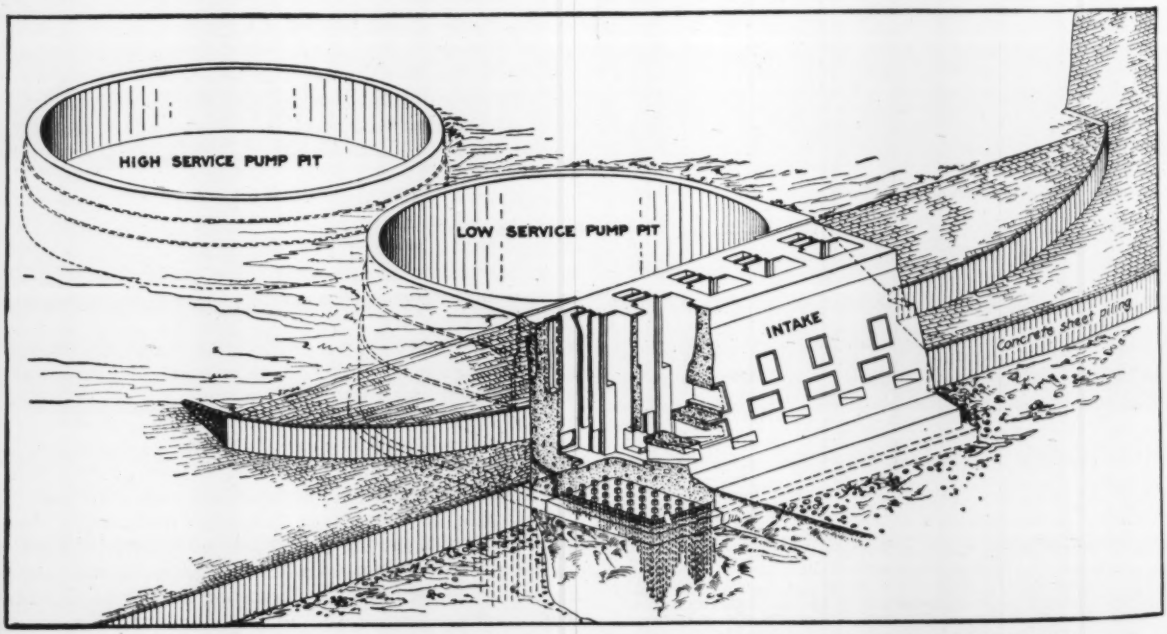


FIG. 2—ISOMETRIC VIEW OF NEW SHORE INTAKE AND PUMP PITS, ST. LOUIS WATER-WORKS

From Job and Office

For Contractor and Engineer

Worn-Out Ford Running Gears Used as Trailers at Philadelphia

By D. A. McCrudden
Assistant to Chief of Water Bureau, Philadelphia, Pa.

RUNNING gears of otherwise worn-out Ford cars are used by the Philadelphia Water Bureau as trailers to carry diaphragm pumps and also (separately) as tool wagons and boxes.

The diaphragm pump (Fig. 1) is a standard gasoline-driven outfit, formerly mounted by the manufacturers on a low truck with small iron wheels and no springs. The weight was about 800 lb. and the running gear was

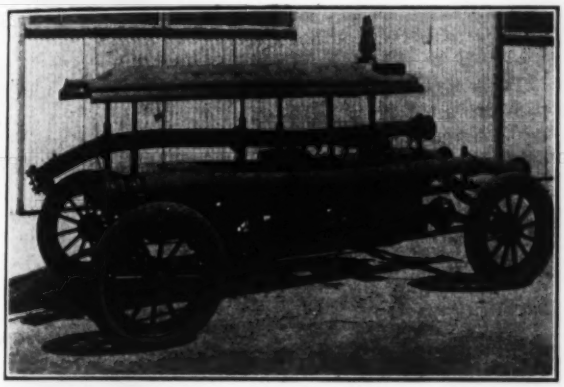


FIG. 1—TRAILER-MOUNTED PUMP FOR REPAIRS

adaptable only for movements at the site of the work. Loading and unloading for long distance transportation required several men and not infrequently resulted in damage to the pump. The unprotected gasoline engine was not efficient in wet weather. Mounted on a Ford running gear, as shown by the accompanying view, the pump equipment is complete with tool boxes, suction hose and proper housing for the engine. The equipment can be handled as a trailer by a Ford one-ton truck.

The trailer tool wagon (Fig. 2) weighs 950 lb. and carries about 500 lb. of tools and equipment, including boots and clothing which the men leave overnight at the job. New tires are not used on the trailer, as it is often left unprotected overnight. When left on the job the wheels are locked.

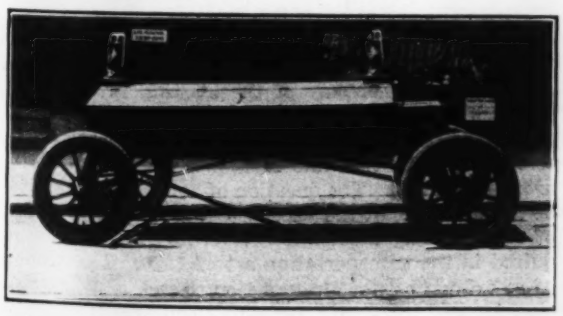


FIG. 2—TRAILER TOOL BOX

One truck, used by the foreman for transportation, is capable of serving from three to five of these trailer wagons, the truck carrying certain special equipment and being always available to bring additional equipment to any job in case of necessity.

Experience seems to indicate that 6 trucks and 22 trailer tool wagons will do the work of 22 horse-drawn vehicles.

Oxyacetylene Welding Outfits Most Useful of Butte's Equipment

By Eugene Carroll
Vice-President and Manager, Butte, Mont., Water Co.

THE MOST useful equipments we maintain in the operation of the plant of the Butte Water Co. are the oxyacetylene outfits for welding and cutting. We keep three complete outfits ready for service at all times, consisting of generator and cutting and welding tools. One outfit is kept at our city shop and is extremely useful in the repair of automobiles and various other parts of our equipment, and also for cutouts in pipe 12 in. or more in diameter. Another outfit is kept at our South Fork reservoir, twenty miles from Butte, at which point there is about three miles of welded-steel pipe with welded joints and about three miles of steel-riveted pipe. The third outfit is kept at our Big Hole pumping station, thirty miles from town, where there is also considerable steel pipe, both welded and riveted.

The generators are kept mounted on skids, enabling us to place them quickly on a truck and deliver them to any point where they may be required for repair work. In our Big Hole pipe line, which was constructed in 1899, we used riveted steel pipe for the heavy pressures. This pipe is beginning to disintegrate, and the cost of repairing would be very great were we required to put on riveted patches at all breaks. Up to the present time the breaks have been longitudinal cracks in the pipe, varying from one to three feet in length and occurring usually near the edge of the steel on the lap joint. With the welding outfit, repairing this kind of a leak is a very simple matter.

The Fable of the Hank o' Lead and the Candle

By M. L. Worrell
Engineer and Manager, Water Department, Vicksburg, Miss.

ONE DAY while away out on "the job," riding behind a nigger who was driving a grey mule, we chanced across a valve leaking through a stuffing-box. Looking around for something to pack it with I found nothing, or at least nothing but a hank of lead-wool, which material had just been put on the market. We had a small piece of plumber's candle which was set afire and furnished the necessary lubricant, and mixing this with the hank o' lead we packed the valve, made a good job, and a lasting one. Since then, after "think-tanking" a bit, we have used it numerous times on different similar jobs with absolute satisfaction. And on each pumping station job, where metallic packing was used, lead-wool has taken its place at less than one-fifteenth the cost and with just as much satisfaction otherwise. If the work of valve-packing on water-gates is thoroughly done, it will never have to be repeated; my word for this.

Chamber of Commerce Meeting of Interest to Engineers

Annual Meeting of National Body of Business Men Devoted Mainly to Transportation and Immigration—General Study of Transportation Now Under Way—Hoover Optimistic on Immediate Future

MATTERS of concern to engineers were the principal topics of discussion at the eleventh annual meeting of the Chamber of Commerce of the United States which nearly 5,000 business men attended at New York City in the week of May 8-11. Transportation was the principal subject under consideration, but some little time in the sectional meetings was devoted to another subject of interest to engineers, namely, immigration. The Chamber is fostering an extended investigation into the subject of transportation and the committees which have it under consideration made preliminary reports, which indicate that the whole subject, including the details of railway organization and its relation to the government and the inter-relation of highway, waterway and railway transportation, will be thoroughly reported on by next fall.

In addresses to the meeting both Herbert Hoover, Secretary of Commerce, and Julius Barnes, the president of the Chamber, voiced a real optimism as to the immediate business future in this country. Mr. Hoover especially called attention to the differences in our present economic position as compared with the situation prior to the collapse of 1920 and showed how great is the production capacity of this country, mentioning how our efficiency of production has increased in recent years, and from this he deduced that we can afford to have tremendously increased production and consumption figures because the standards of living of the people as a whole have been raised. While he advised a certain amount of caution in going into the future, he felt that there was no need of any hysterical retrenchment.

Immigration Policies—The Immigration Committee of the Chamber recommended that the present 3 per cent limitation of immigration be retained, but that to this 3 per cent there be added 2 per cent on a selective basis, this 2 per cent to give opportunity to test the practicability of proposals for selection "so meeting the desires of those who wish a selective basis to replace the restrictive while not affording ground for alarm to those who fear an innovation." The committee stated the selective requirements to be: Meeting a minimum physical, mental, and moral test, and a demonstrated need for immigrants of a particular kind. In his speech, Congressman Johnson, chairman of the House Committee on Immigration, stated definitely that he did not believe that there would be any let-down in the restrictions imposed in a new law. Rather, he thought the restrictions would be tightened by the next Congress and the chances were that a bill would go through which would set the basis of immigration as 2 per cent of the nationals in this country in 1890, with a possible 1 per cent addition for the blood relatives of those already in this country. He stated that there were international difficulties in the way of examination abroad which made it almost impossible to put it in force, but that there was a possibility of registration abroad sufficiently in advance so that some weeding out of applicants could be made in time to select the immigrants before they embarked from the other side.

Allen T. Burns, of the Carnegie Corporation, presented some interesting figures on immigration and citizenship, which seem to disprove some of the older held ideas regarding the source of the best material in this country. He showed that the immigrants who become naturalized quickest are those from such countries as Turkey, Ireland, and Russia, where home governmental conditions are not stable; whereas those from England, Germany, and Sweden are the slowest in taking out their papers. Those in the first group take from eight to ten years and those in the latter from twelve to thirteen. On this basis, he said that it is not altogether safe to throw the standard of selection back to 1890 in the hope of getting the Northern races, because these do not necessarily become citizens any quicker than the Southern races.

Transportation—Realizing that the tremendous expansion in the transportation requirements of the country demand a program of development which will not only take advantage of the best that is in all the existing means of transportation but will also point out the most desirable lines of future development, the Chamber at its meeting last year began a comprehensive study of the present transportation situation from which it hopes to evolve a plan which it can present to the country as a working basis for all future legislation. Assured that it represents the desire on the part of the great majority of the people to stimulate rather than suppress private enterprise, the Chamber took private ownership of the railroads and barge lines as the basis of its transportation program. It then appointed committees to study the problems arising under the following heads: railroad consolidation, government relations, relative rates, motor transport, waterways, and the co-ordination of rail, water, and motor transportation. This year most of these committees submitted interim reports. When the final reports of all the committees are submitted the Chamber proposes to construct a general committee which will fit the separate recommendations into a comprehensive whole.

Obviously the railways will be the chief subject of concern in such a comprehensive transportation system but the potential value of the waterways in handling slow-moving bulk freight and the adaptability of motor vehicles to the rapid movement of small units of freight make it necessary to determine what their proper relation to the railways shall be and to what extent they can be used to advantage in carrying part of the freight now handled by the railways. To do this properly requires a study not only of the existing rate structure for each class of transportation to see that its basis is correct, but also a study to determine the proper distribution of the interline rates when the three classes are co-ordinated. The question of rates leads to a study of the financing of the railroads and of the best method of consolidating them into several large systems as required in the transportation act of 1920. The question of co-ordinating the three major classes of transportation so that they will be supplementary rather than competitive leads to a study of how far such co-ordina-

tion can go under one system before the system will become monopolistic.

Railway Consolidation—The committee on railroad consolidations reports that from the facts which it has been able to obtain it is of the opinion that the popular belief that the chief advantage to be gained from consolidating the railroads into several large systems will result in great economies of administration and operation is, in a large degree, illusory. It is, in reality, of subsidiary importance to the rate adjustments that will be possible under the consolidation, and to the freer flow of traffic that will result from the improvement in the interchange and from the greater flexibility of the car supply. The committee also believes that, contrary to the opinion expressed in many quarters, the consolidation can be so accomplished as to maintain and even enhance the competition in service required by the Transportation Act. The second phase of the committee's report is a study of the measures which will be necessary after the plan of consolidation has been adopted in order to avoid injustice to the present owners of railroad securities due to the consolidation, and finally the consideration as to whether any compulsion will be necessary to effect the consolidation. The committee is of the opinion that the financial arrangements for the protection of the security holders can be settled without difficulty, and that there are no insurmountable obstacles in the way of voluntary consolidation.

The committee on government relations reports that before it can draw any conclusions on a subject concerning which there are such widely divergent views it feels that it should first assemble all the pertinent data and study them to the end that its report will be as nearly unanimous as possible. With this object in view the committee is collecting data regarding the past and probable future traffic, an enumeration and portrayal of the facilities and the financial resources necessary to adequately develop the railways. It is also studying the Transportation Act of 1920 to determine whether it has had a fair test, and to suggest additions or changes in its provisions which the committee may, in the course of its study, find to be desirable.

Waterways—The committee on the development of the waterways and the co-ordination of the rail and water service reports that it is of the opinion that the waterways should only be used to supplement the railways as the railways must continue to be the back-bone of our transportation system. It is also exploring all the existing sources of data to determine what railway facilities can be replaced by water-borne facilities. When this question is answered the committee will take up a study of the rates, both for water transportation alone and for the joint services. This will of course include a study of the fundamental question of the relative cost of the two classes of transportation. Among its broad duties the committee includes consideration of methods of stimulating the greater use of the waterways of the country.

Motor Transport—The committee on the relation of highway and motor transport to other transportation agencies reports that it is of the opinion that its report should cover the conditions underlying the motor, rail, and waterway transportation. That consequently it has organized into three groups to consider: (1) the field of motor use outside the terminal area, (2) the field of motor use inside the terminal area, and (3) the legal aspect of highway carriers in relation to other carriers. The chairman will also look into the matter of the use of gasoline motor cars on the railroads. Each of these sub-committees has made progress in getting at the basic facts. One fact which they have already brought out is that the motor interests of the country are opposed to the use of motor cars for long hauls.

C. A. Newton, Congressman from Missouri, spoke on the co-ordination of transportation facilities. As Mr. Newton is a member of the Rivers and Harbors Board of Congress he devoted the most of his speech to waterways. He outlined in detail the present condition of the railways of the country, pointing out their inability to handle the traffic that is now offered, and then showed that in view of the fact that our traffic, expressed in ton-miles, doubles every ten years we would soon lose sight of the question of rates in our demand for greatly increased facilities. To offset this he considers that the railways, waterways, and highways must be developed to their fullest capacity and used as one great transportation system. But before such a transportation system can be developed two things must be accomplished, First: the projects for the completion of our inland waterways must be completed, and second: the abuses in railroad rates which have in the past stifled competition on the water routes must be abolished so that investments in river equipment will be stimulated and our waterways will be carrying their full share of the country's commerce.

Charles H. Markham, president of the Illinois Central R.R., followed Mr. Newton, speaking on the same subject but from the point of view of a railroad man. He pointed out that the expenditure of great sums of money by the government on waterways and highways was in effect a subsidy to the competitors of the railroads. That in determining the true economies to be derived from highway and waterway transportation due consideration must be given to the cost of building and maintaining these routes. In addition, legislation should be equalized. At present the railroads are burdened with all kinds of restrictive regulations while motor and water traffic have almost none. He also feels that the public are beginning to realize that the prosperity of the country is intimately related to the prosperity of the railroads, and that the reaction against further restrictive legislation which will surely follow will in the end assure to the railroads sufficient income and new capital to develop as the country grows.

Resolutions—The formal resolutions adopted by the Chamber had for high spots a declaration in favor of a general international economic conference and a world court of justice, the loosening of immigration restrictions by adding a selected 2 per cent to the present 3 per cent restricted quota (practically the recommendation of the committee on immigration), the endorsement of the principle that the state should continue to regulate public utilities instead of delegating power to local authorities, and general clauses favoring private operation of government-owned ships, open shop in coal mine operation, improvement of waterways, development of a system of flood control and reclamation of waste lands. Inasmuch as the transportation question is still under discussion for the final report next fall, the resolutions committee did not undertake any specific recommendations.

Professional Work and Internal Problems Before American Association of Engineers

Effective Work for Professional Betterment Comes to the Front—Principles of Conduct Adopted—A New License Law—Other Work in Progress—Serious Internal Problems—Benham Becomes President

Engineering News-Record Staff Correspondence

WITH country-wide representation of delegates from its various chapters, and one representative from as far away as Hawaii, the American Association of Engineers had a notable meeting at Norfolk last week, its ninth annual convention. Some 200 were in attendance. Important national committee work of constructive character bearing on difficult phases of professional betterment was reported, and found approval by the convention. With this achievement the association demonstrated in substantial manner that it can do useful work.

A code of rules of good professional conduct was formulated. A new license law was drafted. An active start was made toward the study of consulting engineering practices. The study of compensation of engineers in public employ was carried forward. Effective action in aid of good national legislation in the interests of the public generally and of engineers was reported upon. A good beginning was made toward outlining the political functions of the association and its members. Useful work was added to what had previously been accomplished in the study of the standing of technical colleges.

But the convention also became involved in a tangle of organizational troubles and disputes which not only brought to light a threatening lack of harmony and various disruptive tendencies but also absorbed a good part of the time and energy of the convention. Constitution tinkering was indulged in extensively, as at previous conventions of the association. A determined effort was made to oust the secretary, on shadowy grounds, the only tangible element of which was that, in the view of some persons, the secretary must be held responsible for the decline of membership of the association. Proposals were offered to change the entire structure of the organization. At the bottom of much of this discussion was the familiar money problem. The actual outcome of the discussions on these business matters, as expressed in various resolutions adopted, appears to represent only a partial and temporary settlement of the questions at issue.

In the following review of the convention doings, the constructive work will be considered first.

Professional Work

Principles of Conduct—Basing on the 40 or more decisions heretofore rendered by the Practice committee in cases of questionable professional conduct presented to it, the committee during the past year compiled a code of principles of sound professional conduct. The principles are in four groups, relating separately to the engineer's relations to the public, to clients or employers, to employees, and to other engineers. They form probably the first definite guiding code of conduct that has been available to engineers. After consideration by the Resolutions committee of the convention, they were adopted as the principles of the association, with the exception of five of the original principles, which were referred back for restudy and revision.

Consulting Engineering Practices—Work on this difficult subject has been divided into several parts, the important ones being rules of practice, standard fees, private work by public employees, effect of Reclamation Service and federal and state highway work upon the field of private engineering, and certain miscellaneous questions such as engineering guarantees and competitive bidding practices. The most definite results so far have been obtained on private work by public employees, on which subject a large mass of material and views has been collected, the conclusions from which are not yet ready. The committee has also begun a study of free engineering service offered in manufacturers' advertisements, and expects to formulate a policy on this subject.

Occupational Specifications—With extensive governmental aid the committee on classification of engineering positions undertook a precise statement of the minimum qualifications of highway engineers in various services, as reported in *Engineering News-Record* of April 26 and May 3, pp. 744 and 793. This work was carried out largely by Prof. A. B. McDaniel. It is to be continued, unless present hopes for the necessary financial support of the work are defeated.

Public Salaries—No attempt was made during the past year to modify the public service salary schedules heretofore drawn up and recommended by the association, but the committee asked that these schedules be reaffirmed and further efforts made to insure their adoption. Other phases of public employ, such as short and insecure tenure of office, civil service classification, permanent staff organization, and the need of more publicity for the value of good engineering of public works, were reported upon by the committee and will be the subjects of further work.

New License Law—The legislative committee during the year prepared a revised draft of a license law on the basis of reports of experience with license administration in various states. Just prior to the convention this draft was further revised by a special committee composed largely of members of state examining boards. Discussion at the convention showed that there are various points in license laws that will continue to give rise to difference of opinion, and that probably local requirements and preferences will dictate certain differences in the laws of different states. However, the revised bill was adopted by the convention and ordered to be published, after editorial correction and full annotation, the latter to indicate what variations in the several provisions may need to be considered. The bill contains suitable administrative provisions, requires a license for practicing or offering to practice engineer-

ing, includes a grandfather clause, and provides as completely for reciprocity as is considered practicable at present.

Political Policies—In the report of the committee on political policies the proper limits of the political activity of the association or its chapters were outlined, and emphasis was placed on the importance of the individual engineer's taking his full part as a citizen in politics. Revised drafts of these principles, formulated by the committee on resolutions, were adopted by the convention. Several other political questions were studied by the committee, including the question whether an engineer in public employ should make contributions for political purposes when called upon, and whether it is ever defensible to support a layman running for the office of county engineer. From the divergent views expressed by the members of the committee on these questions it was evident that moral sentiment on such points is not everywhere crystallized, and that more thinking needs to be done before useful results are obtained.

Railroad Work—Following the abandonment of its appearance before the Railway Labor Board as official representative of professional engineers in railroad employ, the association organized a railroad advisory committee. This committee is working by direct conference with railway executives. It has been able to show some degree of success, but is still in an organizational stage of its work. Sharp difference of opinion within the association as to the right way to deal with the railroad engineers' problem became evident in the course of the meeting.

The Title "Engineer"—Abuse of the term engineer was brought to the attention of the association by the Qualifications committee. No method of dealing with the difficulty was suggested in the report, but recognizing the importance of the subject the convention adopted a resolution asking the organization of a joint committee of engineering societies to deal with the subject.

Efforts at Co-operation—The consistent policy of the association to co-operate with other engineering bodies in questions of joint interest has had little opportunity for application heretofore, apparently because of the unresponsiveness of other societies. Nevertheless, the Norfolk convention recognized the present peculiar conditions in professional circles which call for more active co-operation between societies, and adopted a resolution reaffirming the association's readiness at all times to co-operate in questions of joint interest. A specific recommendation in favor of a joint committee has been noted just above.

Federal Work—Effective work by the association's Washington office in guiding and urging legislation and appointment matters was reported. It included successful efforts in support of the classification act, which lays the foundation for an orderly and equitable arrangement of technical positions in the federal service all over the country, the civil service retirement act, and related matters. Co-ordinate with this activity, the association's federal advisory committee has also worked effectively on legislative and other federal matters. Work in both departments is to be continued actively during the year.

Classification of Schools—With the primary purpose of facilitating the consideration of applications for membership, the Education committee during the past year largely expanded its study of the qualifications and standing of engineering schools throughout the country, begun in the previous year. From the findings so far reported—which, however, are subject to further analysis of the data—it is likely that conclusions of direct value in the improvement of technical schools will develop.

Business Discussions

Quoting from President Johnson's address: "Much important work of the association is accomplished through its national committees. Including standing and special committees, there are eighteen in all, and few organizations have developed a higher degree of effective committee work. First of all the A.A.E. is a national organization, and only by the fact that it is such an organization is it possible to accomplish even those things which may have but a local interest. And while it is true our association functions in many ways through chapters, nevertheless they would be impotent were they not part of a national organization. I believe all of us realize the mistake that was made at the Buffalo convention, which tended towards decentralization. One of the chief problems before the Salt Lake convention was to remedy the results of too hasty action made at the previous convention." Mr. Johnson also referred to the decline of membership in the last year, attributing it to the unsound growth which resulted from the "drives" of a few years ago, following the war period. In these passages, the address pointed toward some of the chief business problems discussed at the convention, which also concerned itself with two other problems, publication and finances.

Publishing Troubles—With the help of a 75c. allotment from membership dues to *Professional Engineer*, the association's monthly showed a slight apparent surplus for the year, with receipts and expenditures about $20,000 each. But the experiences of various chapters in publishing their local bulletins convinced many members that the paper can be made much better in character and very profitable. One member told of the methods by which local merchants have been "induced" to place advertising in his local publication, and claimed that similar methods of genteel persuasion should prove successful in securing national advertising. Half a dozen publishing resolutions were presented, none of which, however, got through the Resolutions committees. Final action took the form of a commendation of the journal qualified by a recommendation to the board of directors to improve it and endeavor to increase its financial success. It should be added that since last fall the work of editing the journal has been carried on by the secretary of the association, in addition to his other duties.

A prominent feature of the discussion was the manifest unwillingness of some of the members to leave essential managerial matters in the hands of the board of directors, based on an implied lack of faith in the wisdom and ability of the board. This same spirit ran through all the other business discussions. It came out again in resolutions to require the Board to publish a membership roster, reimbursing itself by making a charge for the roster.

The Financial Problem—In spite of a 20 per cent reduction in income during the year just closed, which reduction is attributable to loss of membership, a small

operating profit was shown—as against a considerable deficit in each of the preceding two years—as the result of close economy. Expenditures were reduced nearly $60,000, half of this being represented by smaller payments to the chapters and half by economies in the national organization. But the irksomeness of this close economy, the desire by the chapters to have more money for their local work, and the constant pressure to enlarge national activities and to take up new ones, for which the money is lacking, combine to make the financial problem of the association its central source of worry.

The income of about $175,000 per year is by all considered to be insufficient, and meanwhile the membership is in part clamoring for reduction of dues. The treasurer reported that the figures "show conclusively that our association is face to face with a crisis that must be wisely met if it is to survive as a going concern." One phase of the situation is the constant friction between chapters and central headquarters, as suggested in the statement, "Experience has shown that some chapters are altogether too optimistic as to their expected income, and this has resulted in their expenses being greater than their income, resulting in past-due obligations and general disappointment, including actual hostility to national headquarters without any reasonable foundation."

Another phase of the financial problem is reflected in radically divergent ideas between various members as to the ownership of moneys collected. A case was reported involving a chapter which decided to disband; having a considerable sum of money in its treasury left from the share of the dues assigned to it for its local work, the chapter simply distributed this money to the members of the disbanding chapter. Prosecution of the persons involved was begun but by vote of the board at the convention was dropped.

A flood of resolutions to reduce the dues was presented to the convention, partly with the argument that the individual member cannot afford to pay $15, and partly on the ground that the returns are not worth this sum. After extended discussion, however, these proposals were rejected, a roll-call vote on one phase of the subject being 6,636 in favor of leaving the present dues unchanged, against 1,601 for a reduction. A proposal authorizing chapters to fix their own local dues was similarly defeated. In general, the conviction became evident that the financial salvation of the association lies in plugging ahead on the present basis, making sure every dollar spent is turned to good account.

Employment Service—Much discussion of the employment service now conducted by the central headquarters and independently by the larger chapters led to no definite result. But the discussion was marked by the determined demand of many members that the fees now charged for engagements obtained through the service be abolished. Employment service is the principal return which the association offers its member for his dues, it was claimed, and if a fee is charged the chief value of the organization is lost. A supplementary view was expressed in comparisons made by one or two delegates of the national and their own local employment service, which were unfavorable to the former, and assertions by men of the far West that the present national service benefits mainly the men in the Chicago territory. However, it developed that only a few of the Class A chapters are handling their employment service in business-like manner or to good effect, and practically no co-ordination of the local with the national work has been accomplished.

The outcome of all the discussion was (1) defeat of the proposals for free employment service, and (2) demonstration of the vital importance of the service to the association's membership.

Membership—Nearly 10,000 members were lost during 1922. Since the beginning of 1920 the membership figures (for Jan. 1) were 13,000, 24,500, 23,500, 15,000. The loss in membership was explained variously by different parties: It is the secretary's fault; it is largely a loss of railroad members, who became dissatisfied with the absence of promotional railway activity after the association had brought about increases in pay for railway men several years ago; it is due to the ineffective handling of national affairs and the throttling of local affairs by a grant of too little money and exercise of too much guardianship by the central organization, etc. That the quality of the membership is high was shown by the character of the men in attendance at the convention. Nevertheless, the loss of membership is of vital importance, if only because it increases the financial difficulties of the organization. It was decided to enter upon active efforts to rebuild and increase the membership.

Chapter Activities—Various reports on the activities of the local chapters indicated a somewhat unsatisfactory condition, in that some chapters are functioning well and arousing active local interest, while others are not. Many of the chapters have accomplished distinctly good results in connection with local legislation, appointments and improvements. In general, it would appear that the chapters have not yet found a real field of work, useful to the community and stimulating to their own membership. As the chapter work has more direct bearing on the members' interest in the organization than the national committee work or publications, the weakness of chapter activities probably has some causal relation to the loss of membership.

There was a great deal of discussion on the subject of the chapters, many delegates taking the view that they ought to be helped more by encouragement and suggestion on the part of the national organization. It was decided that a special effort should be made to assist, advise and encourage the chapters, through enlargement of the functions of the Chapter Activities committee, and probably also through the appointment of a traveling secretary to advise and encourage the chapters and exchange information on effective local working methods.

Decentralization—The chapter grumbling was the chief motive of further efforts at decentralizing the association. Two years ago, at the Buffalo convention, the first strong effort at decentralization was successful, barely stopping short of making the chapters completely independent units, loosely bound into a federation with clerical headquarters. The grant of local autonomy and a large share of the membership due funds to the chapters was not successful enough to prevent a partial return to the original condition at the next convention. But the preference for freedom from central government has remained strong enough with a minority of the membership to lead to persistent, well-organized efforts at Norfolk to tear down the entire organizational

structure of the association and substitute one based on local and occupational-group independence. The supporters of this movement held that with more money the local chapter is bound to be successful, while the opponents pointed to the demonstrated lack of success of many chapters and the vital importance of the national committee work and other central activities. The efforts in the main were decisively outvoted, although some phases of the proposed reconstruction were referred to the board of directors for consideration.

A matter possibly connected with the chapter problem is the complaint made by one or two committees of apathy on the part of committee members and those to whom inquiries for data were sent. Another committee reported that its work was retarded by an acrimonious spirit of discussion, a further indication that local differences of view are strong and interest in nation-wide problems is affected by more than one difficulty.

Special Activities Demanded—A prominent feature of the reconstruction proposals presented to the convention was the various demands for activities in favor of special occupational groups of engineers. It was definitely proposed that the association be split up in such a way as to segregate from the dues certain sums to be applied in the interest of practicing engineers, engineers in teaching service, railway engineers, and so on. The movement was sponsored mainly by railway engineers, or those who claimed to speak for them. The argument is that since the increases of pay procured for them by the association's efforts several years ago, nothing further has been done for railway engineers, and that every member, and every class of members, expects and should receive full value or more for the dues paid. This value, it is claimed, should be measurable directly in terms of the class benefits received by each occupational class.

One expression of this movement was a radical reconstruction proposal submitted by the Chicago Chapter, under which a Railway Men's Technical Council would be organized within the association but quite independent of it in most respects, to represent professional railway engineers under the Esch-Cummins law. Apparently it would function without much regard to either the chapters or the central headquarters. This body would be supported by allotment of a large share of the dues of railway members of the association. The proposal was defeated, though even after full discussion no approach toward harmonizing of the opposing views was evident, and the vote was strictly factional.

Fight on Secretary—Much of the convention's time and energy were taken up by bitter quarreling over the secretary, C. E. Drayer. Representatives of a number of chapters came instructed to use every means to bring about the secretary's dismissal or resignation. Circular correspondence with all the chapters was initiated on this point by the Chicago Chapter a number of weeks ago. A number of chapters supported the movement, all generally blaming the loss of membership and straitened financial condition of the organization on the secretary, in so far as grounds for the fight were brought out at all. The matter was finally disposed of after the board of directors had strongly affirmed its faith and confidence in the secretary and charged that the criticisms and the opposition, such as they were, directed themselves against the board, whose executive agent the secretary had been. A vote of 5,300 to 2,100 upheld the position of the board.

New Officers—Webster L. Benham, consulting engineer, Kansas City, was elected president for the coming year, winning in a close contest over Robert I. Randolph, of Chicago, and Frank T. Payne, of New Orleans. The new vice-presidents are: Dean G. M. Butler, Tucson, and Morris Bien, assistant director of the Reclamation Service, Washington. The following were elected directors: W. H. Marsh, H. C. Ferry, J. C. Nagle, J. C. Kaulfuss, D. W. Patton, W. R. Harris, M. Z. Balph, and Philip Sellers.

On urgent invitation from the San Francisco chapter, the 1924 convention was allotted to that city.

Disastrous Maine Floods Due to Heavy Snow Storage

Record High Water in Several Streams Follow Rain on Deep Lie of Snow—Earth Dam Fails on Union River

BY GEORGE C. DANFORTH
Chief Engineer, Maine Water Power Commission, Augusta, Me.

HIGH WATER and floods in most of the rivers of Maine during the first part of May caused considerable damage. In April the opinion was generally expressed that the absence of frost in the ground and the empty storage basins would prevent any serious high water during the spring runoff. Snow surveys made during the latter part of March on the Kennebec, Penobscot and Androscoggin headwaters, however, enabled the writer to give information to the press on April 1 that floods of considerable magnitude were to be expected on rivers from the eastern state boundary to as far west as the Androscoggin basin. These surveys showed about 50 per cent more water on the ground than in any recent year except on the Androscoggin where the amount was less than that in the spring of 1922.

TABLE SHOWING SNOW AND HYDROLOGIC CONDITIONS ON MAINE RIVERS—APRIL, 1923

	Androscoggin Above Rumford 2,090 sq.mi.	Kennebec Above Waterville 4,270 sq.mi.	Penobscot Above W. Enfield 6,600 sq.mi.
Average depth snow, inches, 1922	40	18	24
Average depth snow, inches, 1923	39	36	46
Water on ground, inches.... 1922	9.1	6.4	6.2
Water on ground, inches.... 1923	8.2	9.5	9.8
Water on ground, B. Cu.Ft. 1923	39.57	93.97	149.59
Water on ground less available storage.....	9.92	62.67	75.86
Equivalent sec.ft. for 10 days....	11,500	72,800	87,800
Maximum recorded flow — day	55,200	127,000	76,300
Maximum recorded flow — hour	....	157,000	88,700
Maximum recorded flow — date	Apr. 15, 1895	Dec. 16, 1901	Sept. 30, 1909
Maximum daily flow per sq.mi.	26.4	29.7	11.6
Maximum hourly flow per sq.mi.	....	36.8	13.4
Maximum daily flow..... 1923	33,800	120,000	152,000
Maximum daily flow per sq.mi.	16.2	28.1	23.0
Maximum hourly flow,..... 1923	....	136,600	154,000
Maximum hourly flow, per sq.mi.	....	32.0	23.3

Data for the Androscoggin basin furnished by Walter H. Sawyer; that for the Kennebec and Penobscot from surveys under the direction of the writer.

The largest dam affected by the flood was that at Graham Lake on the Union River, which was completed in December, 1922, by the Bar Harbor and Union River Power Co., and which failed on May 2. This is located about five miles above their Ambursen type dam at Ellsworth (see *Engineering News*, May 23, 1907).

The following data concerning this dam are of interest:

Elevation (earth embankment): 112 ft. M.S.L.
Length over all: 1,100 ft.
Length gate section (concrete): 84 ft.

Type: Earth filled. Upstream slope, 3:1; downstream slope, 2:1. Concrete core on steel sheetpiling about 20 ft. upstream from center line of dam, El. 107.
Storage (20 ft. in elevation): 7 b.cu.ft.
Spillway: None. Controlled by gates.
Log sluices: 2 at El. 89.0 and 97.0, 8 ft. wide, concrete.
Gates: 3 steel Fainter gates, 15,000 sec.-ft. capacity; sills at 83.0.
Elevation of high water: 105.

The plans show a 15-ft. apron below the gates. It is believed that this distance was extended somewhat during construction. The material underlying this section was "stiff yellow clay" and "hard clay and gravel." This was excavated to hardpan, and sheet-steel piling was driven.

Officials of the company report that on April 29 the water stood at 103 in the reservoir. On April 30 it had risen to 104 and the gates were opened discharging 20,000 sec.-ft. for 48 hours while the elevation in the reservoir went to 107. The partial failure occurred at about 8 p.m. on May 2, when material under the gate section started to wash out. The excavation increased rapidly taking out part of the gate section and about 30 ft. of the earth fill east of the gates. Considerable of the stored water was released causing an additional rise of about 20 in. at Ellsworth. The dam there was uninjured although the power plant was flooded.

The highest previously recorded flow at the gaging station on the west branch of the Union River (discontinued 1919) was 2,160 sec.-ft. on the area of 140 square miles (15.4 sec.-ft. per square mile) on March 21, 1913. Estimates of the flow here during the recent flood based on an extension of the rating table and local reports concerning flow outside the main channel place this discharge at 7,000 sec.-ft. or 50 sec.-ft. per square mile. Applied to the 452 square miles at the dam this would give a discharge there of 22,500 sec.-ft., a figure which may be in error owing to the inadequate data available.

Had the rains of April 28-29 occurred three or four weeks earlier the maximum runoff would have been greater than any previously recorded and the results would have been disastrous. Not only would the amount of water have been greater but ice and log jams would have seriously complicated the situation. Between April 1 and 28 there occurred only 1.37 in. of rainfall and continued cold weather with sun and wind made conditions far less serious than might otherwise have been the case. The rain of the night of April 28-29 (3.25 in. at Augusta) and the night of 29-30 (1.15 in. at Augusta) was widespread over the state, taking off nearly all the snow and resulting in property damages estimated at between three and four million dollars, particularly on the Kennebec, Penobscot, Union and St. Croix watersheds. Many bridges were washed out and railway, trolley and highway transportation was entirely discontinued over a considerable part of the state.

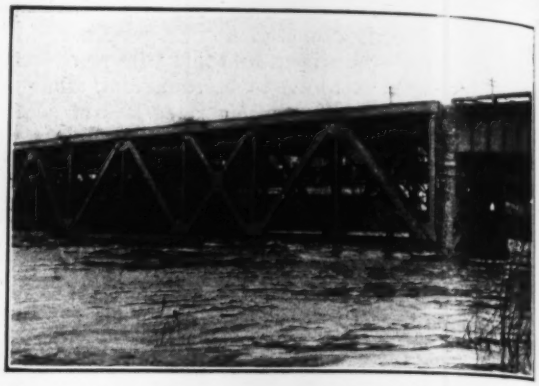


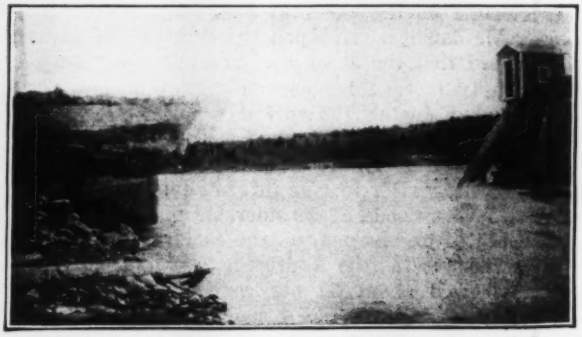
FIG. 3—MAINE CENTRAL R.R. BRIDGE, KENNEBEC RIVER WATER 18 FT. ABOVE NORMAL

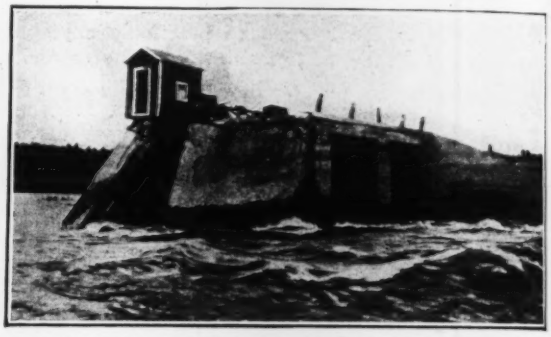
Maximum discharges at a few of our river gaging stations were as follows (preliminary and subject to revision):

	Area Sq.Mi.	Discharge Sec.-Ft.
St. John River at Van Buren	8,270	134,000
Piscataquis River at Foxcroft	286	15,200
East Branch Penobscot River at Grindstone	1,070	30,900
Kennebec River at The Forks	1,570	20,900

Water was 13.5 ft. over the dam at Waterville and 11.5 on the dam at Augusta and was in the ash pits of the steam station of the Central Maine Power Co. near Gardiner. Industrial and hydro-electric plants were in general either flooded out or rendered ineffective by elimination of head on account of extreme backwater.

Some comments might be made concerning the proposed legislative franchise for the Dead River storage reservoir which was vetoed by Governor Baxter during the recent session of the Legislature. When passed over his veto a referendum was invoked by the Governor. The proposed reservoir of ten billion cubic feet capacity would have eliminated the runoff of 500 square miles of area contributing directly to the flood conditions and would have materially lessened the damages on the Kennebec basin. It would also have supplied sufficient storage to enable industries on the river to maintain their low water power at more than present plant capacity.





FIGS. 1 AND 2—GRAHAM LAKE DAM, AN EARTH FILL WITH CONCRETE COREWALL AND GATE SECTION, ON UNION RIVER, ME. FAILED MAY 2, 1913

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Engineers in Railway Service

Sir—Referring to letter signed "Railway Engineer" published in *Engineering News-Record* of April 19, 1923, p. 720, I beg leave to reply to the statements expressed, in the name of the large number of loyal engineers in the railway service.

It is true that engineering employees are transferred from time to time in the interests of the service. In its very nature a railroad's business covers large areas of country and its plant requires attention in its various locations. Men are used in one locality as much as possible, but it is necessary for a man who desires to rise in the railroad world to become acquainted with his railroad's property; this cannot be done very fully without moving. Transfers often mean increased pay and opportunity, and free transportation for the engineer and his family is furnished and generally for his effects as well.

Railway salaries I think average up with any other line of engineering rates of pay, continuity of service and all things considered. They are generally insufficient in all lines.

It has been my observation that most engineering department employees considered their work broadening and not narrow and that the many varieties of work encountered and satisfactorily performed well fitted them for other than railroad work. The large number of successful engineers with railroad experience all over the country tends to show that railroad engineering is instructive.

The charge as to advancement of relatives, etc., is from my observation particularly objectionable. The railroad officers of this country, to an extent I think not shown by any other business, have risen from the ranks step by step, being the products of successive selections of the most fit material in the different grades which they have occupied. A railway organization more truly represents the American ideals of self achievement than any other business of which I know. A railroad officer achieves success only by getting his work done properly, usually under the spur of competition. To have that work done well it is necessary that the best men available be selected to do it or he himself fails. Self protection if nothing else would require selection of competent men for positions of responsibility and not friends and relatives.

The "Bullying and insulting tactics of many railroad executives and their encouragement of such methods" does not deserve much notice, as in any large business conducted in an orderly way a certain discipline must be maintained, but it sits lightly on those who do their work well. The atmosphere of the average organization is exceedingly pleasant and the *esprit de corps* is remarkable.

It can be stated as a fact that there is no royal road to high position in the railroad service and the aspirant for position must bear the heat and burden of the day, but for well prepared, able young men of character there is an opportunity for exercise of ability with the accompanying rewards for success and an immense satisfaction in a connection with a properly functioning transportation system.

JOHN LANSDALE, Valuation Engineer,
Houston, Texas, Southern Pacific Lines.
April 25, 1923.

[It is refreshing to get an impression of this kind from an engineer who has worked up in the railroad service from the position of a rodman, and who feels that the frequent moves that railroad men are called upon to make are, in the long run, worth the price.

The principle underlying what Mr. Lansdale says about the need of such moves is obviously correct but the method of making them, which is still in vogue on most railroads, is not above question. If a man's services to a company are of such a character that he deserves advancement, then it would seem that he should be consulted before the final decision to move him is made, rather than keep him in the dark until time to make the change and then order him to make it at once. Such a sudden change often puts him or his family to great inconvenience.

Undoubtedly on some of the great railroads of this country "bullying and insulting" of junior officials and men is a thing of the past. Unfortunately that is not true on all our railroads. It still exists to a surprising degree on one of the largest systems on this continent, starting with the vice-presidents and spreading down through the whole organization. Discipline can be, and is, maintained without such tactics.—EDITOR.]

How Can We Stop Duplication of Orders?

Sir—Regarding the editorial in *Engineering News-Record*, April 26, I wish to advise that our policy in placing orders has been to cover fully the jobs which we have on hand and not to prospect on propositions in the future. If a contractor wishes to protect himself to take care of a rise in the market I think there should be some manner in which he should protect the manufacturer so that the manufacturer would not be a victim of loss in case there should be a fall in the market or in case of cancellation of orders.

At this particular time when the building trades are so busy the placing of promiscuous orders is very serious and a procedure which should be stopped, because the contractor with a bona fide order and a contract to fulfill is sometimes made the loser on account of the fact that a less responsible contractor might cover himself for quantities which he may think he will need.

Pittsburgh, May 8. J. B. KELLY,
Mellon-Stuart Co., Contracting Engineers.

Sir—We are very much in sympathy with your apprehensions with respect to the rising cost of materials and the shortage of labor, and we are with you very much in the movement to establish conditions on a more sound, stable and continuing basis. We are at every opportunity advocating this with our bankers and prospective building owners.

We do not find, in so far as contractors are concerned in this locality, however, a duplication of orders on manufacturers. They are only buying what they require for specific work. I have analyzed this pretty thoroughly and believe that this statement covers the situation in this district accurately. We do not believe that dealers are altogether frank in some of the statements that are being made, at least so far as some sections of the country are concerned, but we believe that with the proper attitude on their part, cancellation could only be had on a basis of reimbursement that would be satisfactory to them.

It is possible that there are equipment dealers taking advantage of the situation in placing orders with their manufacturing connections for more than they have any idea of using, in the hope of getting what they expect to use and cancelling the remainder of their order. This is a vicious practice and should be abandoned, but we believe it could be well handled at the source.

We are glad to have this opportunity to discuss this matter by correspondence, and we firmly believe that we will not have difficulty in this section in the respects mentioned. If the manufacturers will establish a closer connection between themselves and the users of materials and equipment, they will find they have eliminated a great many of the troubles they are now experiencing.

In our opinion there are entirely too many agents and middlemen representing manufacturers and we think this is one of the important elements in the rising costs. We do not hesitate to make the statement that, in so far as our business is concerned, the agent, unless he carries a stock on hand, is a liability in a transaction rather than an asset

to us. You will find on close analysis that the difficulty is not with the buyer, who is capable of handling properly the enterprise in hand; very likely it is not with the manufacturer so much; more likely will it be found with the distributor who takes no chances whatever and represents a profit entirely incommensurate with the service rendered. Wherever it is possible we buy direct from the manufacturer, and we have no complaints to make against those with whom we are regularly doing business.

H. W. BAUM,
President, H. W. Baum Co., Engineers and Contractors.

Salt Lake City, May 8.

Sir—I have read the editorial in *Engineering News-Record* of April 26, with reference to the protection of building material and the duplication of orders. It is difficult for me to realize that such a practice is as prevalent as you say it is, for I have always felt that a material contract was as binding upon the buyer as upon the seller. There is no question in my mind that the obligation arising out of such a contract is mutual, and should not be subject to cancellation except for a cause, and by mutual consent of both parties to the contract.

C. S. LAMBIE,
President, The C. S. Lambie Co., Engineers and Builders.

Denver, May 8.

Roadway Widths and Traffic

Sir—The paper by O. L. Kipp, construction engineer, State Highway Department of Minnesota, in your issue of April 19, 1923, p. 699, is interesting. The economics of highway design is a subject that is of great importance and one to which, quite generally, too little attention has been given.

Mr. Kipp's paper presents the matter clearly and in terse form, but some of his assumptions and, therefore, some of his conclusions seem doubtful. His ideas as to the value of reducing distance and grades are by no means conclusive and it is extremely doubtful if a problem involving the many variables to be considered in highway traffic can be reduced to such a mathematical analysis; but the point in his paper to which special attention should be called is his discussion of roadway widths. He makes the assumption that if a roadway width of 30 ft. gives one hundred per cent traffic capacity, a width of 24 ft. has fifty per cent and a width of 20 ft. has twenty-five per cent capacity.

At any point and time, a roadway will have one, two, three or more vehicles in a line transverse to the roadway, and the capacity of the highway is determined by the lines of travel it will accommodate. A roadway 18 ft. or 20 ft. wide is adequate for two lines of traffic and since, in the majority of cases, there is a marked preponderance of travel in one direction, at a particular time, there is usually an opportunity for the faster moving vehicles to pass the slower ones without interfering with travel in the opposite direction. This fact makes the usual highway width of 18 to 20 ft. capable of carrying a larger percentage of traffic, per unit of width, than any other. It is difficult to see how a roadway 24 ft. wide will accommodate more traffic than one 20 ft. wide, since it is evident that a width of 24 ft. will not sustain three lines of traffic; or, if it is contended that it will, certainly 30 ft. will not sustain four lines. The only advantage a 30-ft. roadway has over a 20-ft. roadway, so far as traffic capacity is concerned, is that the 30-ft. roadway provides a lane through which high-speed traffic can more readily pass slowly moving vehicles, and this advantage of a 24-ft. roadway over a 20-ft. roadway is of very much less importance. Therefore, Mr. Kipp's assumption that a 24-ft. roadway has only 50 per cent of the capacity of a 30-ft. roadway, and that a 20-ft. roadway has only 50 per cent of the capacity of a 24-ft. roadway, is evidently incorrect and the conclusions based upon these assumptions are equally incorrect. Speaking generally, the assumptions made in the paper seem preconceived to sustain the argument for wide, direct highways paved with concrete.

It is conceded that many highways should be paved with concrete and that they should be wide and direct, but the mileage of such highways is very small compared with that mileage which can be made entirely adequate without the expenditures which Mr. Kipp's suggestions would entail and without the terrific traffic costs which he would charge to a less expensive type of construction.

A highway should be designed for the traffic it is to carry, just as a bridge or other structure, and expenditures for refinements should be made only after it is thoroughly demonstrated that they will result in an adequate return in traffic facility. It is feared that reasoning along the lines of Mr. Kipp's paper will not secure this result. In many places in this county, an extravagant expenditure of money in road construction has caused a reversal of sentiment that makes it difficult to proceed with any road program even though it be conservative and well within traffic needs.

L. R. ASH,
Consulting Engineer.

Kansas City, Mo., May 3, 1923.

More on Concrete Rock Borers

Sir—The report of Dr. Kofoid and Mr. Miller on the finding of rock borers in concrete at San Pedro, Calif. (*Engineering News-Record*, March 15, 1923, p. 499) may have over-emphasized the economic importance of these animals as indicated in the communication of Mr. Squire and in your editorial (*Engineering News-Record*, April 5, p. 608) but it must be remembered that these animals belong to the same group as the teredo and that with the increase in the amount of concrete subject to attack, they may increase in activity as the teredo undoubtedly has.

A report of an attack by the same animals has recently been received from Panama. The French dock at La Boca was built in 1898 on cylinder piers 5 m. in diameter. These piers were constructed in steel caissons 5 mm. thick, the steel being left in place, and it is thought that the concrete was of the same quality as other structures now in good condition, built by the French at the same time in the immediate vicinity on shore. This dock was condemned about two years ago and at an inspection made by engineers and a biologist belonging to the canal force on Nov. 15, 1922, it was found that the steel caissons had corroded through, or been destroyed by abrasion in a number of places.

At each point where the casing had been destroyed, it was found that there was a heavy attack of borers of several species and that the concrete was badly disintegrated. Whether the borers or the disintegration caused the first damage is not known, but the borers undoubtedly accelerated the action.

The general disintegration of concrete in sea water is caused by the action of the sulphates in the water on the free lime of the cement and the increased area offered to this attack as the result of the boring by animals undoubtedly increases the rate of dissolution of the concrete. There seems so far to be no evidence to prove that the borers will or will not attack undamaged concrete of maximum density, but the evidences of destruction from two ports so widely separated as La Boca and San Pedro certainly indicate such possibilities that it is unsafe to disregard the warning of Dr. Kofoid and Mr. Miller.

As stated in the editorial, however, the disintegration of concrete in salt water offers a problem of much greater importance, one which our committee is studying very carefully and one which deserves much more consideration than it has received from engineers in general. As in the case of the marine borers, the engineer must make more intelligent use of the work of the pure scientist than he has generally done if he is to build enduring structures.

WILLIAM G. ATWOOD,
Director, Committee on Marine Piling Investigations of the National Research Council.

New York City,
April 16, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The City of Columbus, Ohio Will Pave 25 miles of streets in 1923, if the projected program is carried out. This is more than any year since 1908, when 26.7 miles were paved. The total for the past ten years was 120 miles.

The State of California Requires the Services of a large number of engineers and draftsmen to carry out an extensive program of the California State Highway Commission and other engineering divisions of the state government. Requests for information should be addressed to the California Civil Service Commission, Forum Bldg., Sacramento.

Philadelphia is to Have a New Grain Elevator, built by the Reading R.R. Co. at Port Richmond, and costing over $3,000,000. The capacity will be 2,500,000 bu. and provision is to be made for increasing it to 3,500,000 in the future. With the addition which the Pennsylvania R.R. Co. is making to its elevators at Girard Point, the port of Philadelphia will have a working capacity of 6,000,000 bushel.

Award of a Contract Has been made by the Ford Motor Co. to Stone & Webster, Inc., Boston, for the building of a 10,000-hp. hydro-electric power plant on the Menominee River, near Iron Mountain, Mich. Other contracts to Stone & Webster are a hydro-electric and steam power plant and manufacturing buildings at High Dam at St. Paul, Minn., and hydro-electric power plants at Green Island, N. Y., and Flat Rock, Mich., the last two being recently completed for the Ford Motor Co.

Suit Has Been Filed in the Superior Court against the city of Tacoma, Wash., Ira S. Davisson, commissioner of light and water, and B. E. Torpen, engineer employed on the Lake Cushman power project, by Benjamin H. Petley, who claims that he should have the position held by Mr. Torpen. The complainant asserts that Commissioner Davisson, disregarding the civil service law, appointed Mr. Torpen when Mr. Petley, after taking the civil service examination, was given rank No. 1.

Among the Bills Which Passed the New York legislature at its recent session and now before Governor Smith are the Ryan bill appropriating $300,000 for the construction of a barge canal grain terminal at Troy, the Downing bill appropriating $1,000,000 for emergency repair work to highways of the state, and the Hackett bill authorizing construction of a bridge across the Hudson River at Poughkeepsie and appropriating $200,000 as the 1923 construction expense involved therein.

Motor-Vehicle Registration Now 12,239,114

According to figures just made public by the National Automobile Chamber of Commerce, New York in its annual publication, "Facts and Figures of the Automobile Industry," there were registered during the year 1922 in the United States 12,239,114 automobiles and motor trucks. Automobiles totaled 10,863,389 and trucks 1,375,725. California was the largest user of passenger automobiles, with 822,394, and New York State led in commercial vehicle registration with 185,858.

The gain in total registration for 1922 as compared with 1921 was 1,755,109 vehicles.

During 1922 the motor car output was 2,406,396 vehicles and the motor truck output 252,668.

Northern Canada Power Co. Gets Des Quinze Falls Lease

The right to develop power on the upper series of fifteen rapids on the Quinze River, known as Des Quinze Falls, near the head of Lake Timiskaming, Que., was sold at auction by the Quebec government at the city of Quebec on April 25. The successful bidder was Alexander Fasken of Toronto, on behalf of the Northern Canada Power Co. A lease of the power rights for 60 years was offered at an upset rental price of $8,000 per year and the competition was very keen, rival bidders being the Nesbitt Thomsom Co. of Montreal and the Montreal Engineering Co., Ltd. The lease was finally awarded at an annual rental of $80,100. In addition to this a special tax of 50 cents per hp. is imposed on all electric energy exported from the Province of Quebec. The conditions of the lease require the starting of power development within eight months and the production of 20,000 hp. within a period of four years. The possible development is estimated at between 50,000 and 60,000 hp. The principal markets for the power will be the Porcupine gold field and the new gold area in Quebec. The Northern Canada Power Co. will begin development immediately.

Big Creek-Los Angeles Line Now Carries 220,000 Volts

After preparations extending over many months, on the morning of May 6 the Southern California Edison Co. changed over from 150,000 volts to 220,000 volts on the 240-mile transmission line from Big Creek to Los Angeles. Although other transmission lines have been designed for this voltage, this is understood to be the first system that has actually transmitted power at this voltage.

N. Y. State Reorganization Bill Now Before Governor

One of the thirty-day bills passed at the recent session of the New York Legislature and now in the hands of Governor Smith is Senate Bill 1045, introduced by Senator Walker and known as the Public Works Law. The proposed act establishes the Department of Public Works which shall include the Bureau of Canals, the Bureau of Highways, and the Bureau of Public Buildings. It was originally planned to include the Department of Architecture in the Department of Public Works, but this provision of the act was stricken out before its final passage.

The act, therefore, transfers to the superintendent of public works duties now exercised by the Commission on Boundary Waters Between the United States and Canada, the Commission of Highways, the Interstate Bridge Commission, the trustees of public buildings and the superintendent of public buildings. Terms of these officers are to expire when the law takes effect, unless reappointment is made by continuing as bureau chiefs the heads of existing state departments. The act proposes the establishment of the offices of commissioner of canals and waterways, the commissioner of highways, and the superintendent of public buildings, each to be appointed by the superintendent of public works.

In the event that Governor Smith signs the bill, the act is to take effect July 1, 1923.

Timber Preservation Progress in New Jersey

Tie and timber men from all over the country were enabled to make an unusually complete inspection trip on May 9 and 10 through arrangements made by C. M. Taylor, superintendent of the Port Reading Creosoting Plant. The trip began with an inspection of various installations of treated ties on the Philadelphia Public Service Electric Ry. This was followed by an inspection of experimental ties at Stratford and a trip to Atlantic City. On Thursday the party started at Philadelphia and went to Port Reading, N. J., over the Reading R.R., stopping en route to examine several out-of-face tie installations and experimental sections in which different kinds of ties and different methods of treatment had been used. At the Port Reading Creosoting Plant the plant officials demonstrated the results that they were obtaining in treating various hard and soft wood ties. Sample ties from each class were sawed and split to show the depth and kind of penetration which had been obtained. The tests were of particular interest as the Port Reading Plant is experimenting in the use of a mixture of 30 per cent English creosote and 70 per cent fuel oil for full-cell treatment. This is a distinct departure from the usual practice.

Engineering News From the Railroads

Construction Work Has Begun on the Northern Pacific's new 35-mi. line into the Castle Rock country in Montana.

Contracts Have Been Let for the construction of a 35-mile railroad into the Tea Pot Dome Oil fields in Wyoming.

The Minneapolis, St. Paul and Sault Ste. Marie R. R. Co. reports a net income of $995,416 for 1922 as against a deficit of $6,237,672 for 1921.

The Southern Pacific Has Been granted authority by the I.C.C. to begin the construction of a new line 21 mi. long into agricultural territory near Bakersfield, Calif.

The Net Income of the St. Louis-San Francisco R.R. Co. dropped from $3,225,680 for 1921 to 753,013 for 1922. The decrease is largely due to the effect of the shopmen's strike.

One of the Largest Pieces of new railroad construction undertaken in recent years is the construction of a line from Miles City, Mont. to Bucknum, Wyo., a distance of 330 miles.

The Interstate Commerce Commission has placed a tentative valuation of $129,810,913 on the property of the Oregon-Washington Railroad & Navigation Co. The company's own valuation is $156,642,559 while its outstanding stocks and bonds have a par value of $152,840,671.

The Maryland, Delaware & Virginia Ry. has been sold to the E. B. Leaf Co. of Philadelphia. The purchaser will scrap the whole line unless they get a satisfactory bid for all or a portion of it from parties interested in maintaining the railway for the operation of self-contained motor cars.

Additions to the Extensive Freight yards at Mingo Junction, near Steubenville, Ohio, are to be made by the Pennsylvania R.R. at a cost of $514,000, making the total cost of these yards nearly $5,000,000. Besides twenty-three new tracks with capacity for 1,360 cars, there will be a new car repair shop, machine shop, oil and store houses, a 50,000-gal. tank and a caboose yard.

Authority Has Been Given by the Interstate Commerce Commission to the Chicago, Peoria and St. Louis R.R.. a line 234 miles long, permission to abandon the whole line. This is the largest railroad in the country to be abandoned, and as it runs through a prosperous country the action has aroused considerable interest in the need of consolidating these small lines with the large railway systems.

The Interstate Commerce Commission has denied the application of the Wenatchee Southern R.R. Co. for authority to build a railroad south from Wenatchee, Wash., to a connection with the Chicago, Milwaukee & St. Paul, and the Oregon-Washington R.R. and Navigation Co. The commission, has, however, granted the company an opportunity to make a second application which will show in detail the need for the new railroad.

Gen. Henry M. Robert Dies

Brig.-Gen. Henry Martyn Robert, U. S. Army, retired, author of Robert's Rules of Order, and former Chief of Engineers, died at Hornell, N. Y., May 11, age 86 years. Gen. Robert was born in Robertville, S. C., May 2, 1837. He entered the U. S. Military Academy in 1853 and upon graduation in 1857 was made assistant professor of natural history and astronomy and acting assistant professor of practical military engineering. A year later he was ordered to Washington territory with a detachment of troops to take command of engineering operations in a campaign against the Indians in Oregon and Washington. After several years' service in the West he was ordered East, just before the outbreak of the Civil War, and at the beginning of hostilities was placed in charge of the construction of a portion of the defenses in the city of Washington. This responsibility proved too heavy a strain, as his health had been undermined seriously by an attack of Panama fever contracted while taking troops to Washington territory via the tropics; he was transferred to Philadelphia for the construction of defences. Later, his health again proving insufficient, he was transferred to New Bedford, Mass., where he continued throughout the war. After the war he was placed in charge of the department of practical military engineering at West Point.

In 1867 he was transferred to San Francisco as chief engineer of the military division of the Pacific. Subsequent transfers placed him in charge of defenses of the Columbia River and the operations of the 13th Lighthouse District, of harbor improvements in Oregon and Washington, of lighthouse construction on Lake Michigan, and harbor improvements on Lake Michigan, Green Bay, and Lake Superior. Later activities were various river and harbor work on Lakes Erie, Ontario, and Champlain, and the St. Lawrence River. The Corps of Engineer activities in the neighborhood of Philadelphia were under his charge for five years. In 1890 he became engineer-commissioner of the District of Columbia and in 1891 was placed in charge of improvements on the Tennessee, Cumberland, and other rivers. Still later he supervised river and harbor work on Long Island Sound and the fortifications of Long Island Sound and New York Harbor.

In 1895, with the rank of colonel, General Robert began the most fruitful period of his engineering career. He was made division engineer of the Southwest Division, which included eleven engineer districts from Pittsburgh to Galveston, with headquarters in New York. He continued in that capacity until April 30, 1901, when he was made Chief of Engineers, U. S. Army, and given the rank of brigadier-general. However, under the operation of the retirement law he held the position for only three days.

Though General Robert will be long remembered as closely connected with engineering operations in many parts of the United States, probably the port and city with which his name will be most connected is that of Galveston, Tex. Following the tidal wave disaster there in 1900 he was appointed chairman of the board of engineers to report on methods of preventing destruction by future tidal waves. The board's studies resulted in a recommendation for a sea wall, which, under modified design, was built and has effectively served the city on two subsequent occasions. After the storm in 1909 General Robert was called in again to report on the repair of the damage and again after the great storm in 1915 he was called upon to recommend still further measures of protection.

A biography in appreciation of General Robert's contributions both as an engineer and as a parliamentarian appeared in *Engineering News-Record*, April 22, 1920, p. 798.

Penn State to Hold Conference on Industry and Engineering

The fourth industrial and engineering conference sponsored by the engineering school of Pennsylvania State College is to be held May 25 and 26. The engineering extension convention is held the two days preceding to outline the educational work carried on in the industries. The purpose of the conference is to bring representatives of Pennsylvania industries employing technical men into closer contact with the college for the study of problems of mutual interest.

Listed in the program are the following subjects for discussion:

"Industrial Research and How Can the College Aid," "What Industry Expects of the College Graduate," "The Department of Labor and Industry and Technical Education," "Engineering Extension, What Is It?" "What Will Be the Demand for Trained Technical Men During the Next Decade," and "How and to What Extent Can the Industries and the Engineering Experiment Station Co-operate in Research."

Aside from the set program visitors will be given an opportunity of visiting the school of engineering and other branches of the college.

The conference arrangements are being made by R. L. Sackett, dean of the engineering school.

Pennsylvania Holds to Former Position in Shop Crafts Case

The Pennsylvania R.R. Co. will be called before the Railroad Labor Board on May 21 for a hearing to determine if it shall be cited for violation of another decision of the board. This action is to be taken in view of the railroad company's definite refusal to hold another election to select employee representatives in the shop crafts despite the adverse ruling of the Supreme Court. Samuel Rea, president of the road, states, in this connection, that conditions have materially changed since the Labor Board issued its order; that the shop crafts employees have indicated their approval of the former election by the unanimous vote of their 775 elected representatives to retain the present plan of employee representatives; that in effect the Supreme Court decision approved the action of the railroad company; and that under these circumstances the company has no choice but to abide by the employees' decision.

Traffic Association Holds Annual Meeting

Committee Reports Stress Need of Extending and Unifying Measures of Highway Safety

DEFINITE recommendations to guide the design and construction of highways in the interests of safer traffic were embodied in the committee report submitted by H. Eltinge Breed, consulting highway engineer, New York, at the annual meeting of the National Highway Traffic Association held in New York City, May 10. In addition, nine other progress reports were received from committees on danger signs, mechanical devices, motor-vehicle regulation, truck overloading, grade crossings, transport franchises and clearing houses, and highway financing. The afternoon and the evening sessions of the meeting were presided over, respectively, by Arthur H. Blanchard, of the University of Michigan, president of the association, and David Beecroft, directing editor, Class Journal Co. New York, vice-president. The evening session was featured by an analysis of the national transportation problem by J. Rowland Bibbins, consulting transportation engineer, Washington, D. C., and a statement of policies affecting equitable distribution of highway construction costs by William H. Connell, recently appointed assistant state highway commissioner of Pennsylvania.

Safety Recommendations

The figures presented in Mr. Breed's committee report showed that the total registration of motor vehicles in the United States is now more than 12,000,000, that 14,000 deaths from automobile accidents occurred in 1922, and that 90 per cent of the automobiles and trucks operate upon 10 per cent of the nation's highways. To insure traffic safety under these conditions the committee included the following in its recommendations:

Banking on all curves of more than 3 deg., the superelevation to vary from 0 for a 3-deg. curve to 1 in. per foot of width for curves of 20 deg. or sharper; widening curves of more than 4 deg. ½ ft. on the inside for each 1-deg. increase in curvature; painting guide lines on pavements at all vertical or horizontal curves; providing 500 ft. of clear sight at vertical or horizontal curves; making radius of curves not less than 1,000 ft. under special conditions; erecting guard rails on inner edge of all curves of more than 8 deg.; elimination of advertising signs; progressive elimination of grade crossings; widening single-track bridges to double-track width; providing sidewalks along highways in congested areas.

In his report on highway danger signs, G. C. Dillman, deputy state highway commissioner of Michigan, recommended the use of distinctive shapes of sign to indicate various traffic directions. The meeting, however, expressed its preference for indicating danger or caution by descriptive or graphic means.

The color red, according to the report on mechanical devices for traffic regulation by Prof. Louis W. McIntyre, University of Pittsburgh, should not be used for traffic regulation signs, control lights or anything except to indicate danger of the first degree. Position lights, in his opinion, are better than colored lights for traffic control signals. For the relief of traffic congestion in cities, Prof. McIntyre believes that progressively controlled signals are more effective than synchronously controlled signals. The progressive control system would make traffic move in platoons which would not stop until they had traversed the complete length of the main thoroughfare.

In reporting on motor-truck regulation, George H. Pride pointed out that the high speeds made possible by the use of pneumatic tires on trucks originally designed for solid tires called for more powerful braking equipment than ordinarily exists.

The new standard caution plate for motor trucks adopted in January by the Motor Truck Division of the National Automobile Chamber of Commerce was described by D. C. Fenner, of the International Motor Co., New York. The new plate provides space for inserting all the weights needed for rating, classification, licensing, operation and regulation of the truck.

Highway financing methods, according to the committee report of William H. Connell, must be adapted in every case to local conditions. As a general principle he stated that original construction cost should be a capital charge, but that the cost of maintenance and of replacement, even when a higher type of surface is substituted for the one originally used, should come out of operating revenue derived from the user of the road. As part of its policy of safety to traffic, Commissioner Connell announced that the Pennsylvania State Highway Department had adopted as standard a wire-cable guard rail at curves, embankments and other danger points, and that this single detail of its program would require the expenditure of $750,000 per year for the next four years.

This year's officers of the association were re-elected for another term. They are: President, Arthur H. Blanchard, University of Michigan; vice-presidents, David Beecroft, R. C. Hargreaves, L. A. Nares, Charles M. Upham, and Jack F. Witt; secretary, Elmer Thompson; treasurer, George H. Pride.

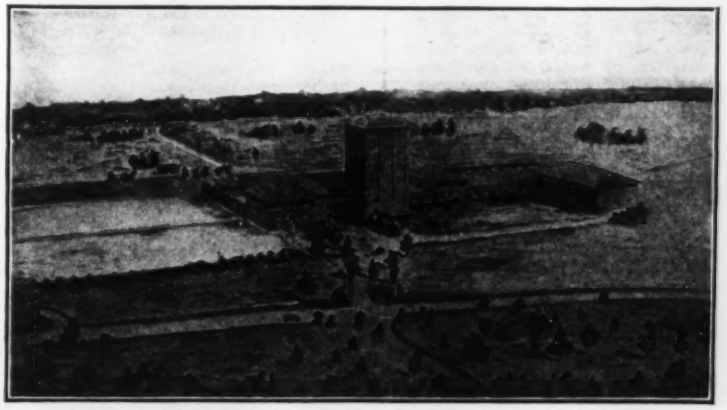
Ohio Sewer Rates and Maintenance Act Becomes Law

The bill authorizing Ohio cities and villages to charge for the use of sewers and to provide for the proper operation and maintenance of sewerage systems and sewage-works has become a law without the signature of the governor, provided that within 90 days a petition for a referendum vote on the bill is not filed. The bill was enacted substantially as outlined in *Engineering News-Record*, March 15, 1923, p. 509, except that in "home-rule charter" cities the authorities may designate the official or department that shall administer the provisions of the act.

Re-grading Project Under Way on Beacon Hill, Seattle

A contract for sluicing 1,500,000 cu. yd. of material from the ungraded portion of Beacon Hill, Seattle, into tidelands along Ninth Ave. South of Sixth Ave. South, has been entered into by property owners of that district and the Puget Sound Bridge & Dredging Co. The price is 39c. per cu.yd. and the work is to be completed within twenty months. William H. Lewis, former manager of the sluicing department of the company, will be in charge.

Mechanical Filtration Plant for Washington, D. C.



INSUFFICIENCY of the Congressional appropriation has made it necessary to postpone until next winter the call for bids for the additional filtration plant for the water supply of Washington, D. C., instead of letting the contract in July, as was intended. The Corps of Engineers, U. S. A., estimates that two years will be required to build the plant. The existing filters, which have been in use for a number of years, are of the slow sand type. The new ones will be rapid or mechanical filters, forming a part of the works for an additional supply of water to the District of Columbia. There will be twenty 4-m.g.d. units. Allowing for two units being out of use for cleaning, the new plant will have a working capacity of 70 m.g.d. or slightly more than the existing slow sand filters. The plant will follow the general lines of the one now in use at Baltimore, Md. It is planned to use the surplus water to develop power for the operation of the pumps. For a number of years to come there will be a large surplus of water, from which it will be possible to develop some 1,500 horsepower. A general view of the projected plant is shown above. It was designed by the U. S. Engineer's office, Charles H. Rener, Architect.

Suggest Metropolitan Planning Committee for Chicago

Regional planning for Chicago has been given a start by a call for the appointment of a committee of twenty-one members by the president of the City Club. At least one-half are to reside outside the city limits. Addresses at the recent initial meeting of public officials and interested citizens were made by Samuel Insull, president of the Commonwealth Edison Co., on future power development; Dr. W. H. Evans, former health commissioner, and feature health writer for the *Chicago Tribune*, on health and sanitation; Harry Pearson, mayor of Evanston, on suburban housing; Jacob L. Crane, city planning expert, on the necessity of a plan to prevent haphazard growth; C. H. Wacker, head of the City Plan Commission, on what has already been done; and Prof. Charles E. Merriam, on the governmental obstacles.

Road Contractors Must Finish 1923 Work to Get 1924 Jobs

Contractors building roads for the Indiana Highway Commission must complete their projects on scheduled time this year or they will be regarded as unfit to compete in the bidding for 1924 contracts, according to John D. Williams, director of the commission.

"Indiana is going to have a completed system of main market highways not only connecting all parts of the state, but facilitating interstate and transcontinental traffic by the end of 1925, and the state highway commission does not propose to be delayed by the failure of contractors to complete their work within a specified time," Mr. Williams said.

Under the three-year paving program of the commission, 153 miles of highway will be hard-surfaced this year, 405 miles in 1924 and 400 miles in 1925, Mr. Williams said. Mr. Williams said that in 1922 the paving program proposed for the year was almost entirely completed on time.

Cacapon Dam Under Control of Federal Power Commission

The project of the Cacapon Power Co. on the Cacapon River, near Martinsburg, W. Va., has been found to come within the jurisdiction of the Federal Power Commission. The project involves the erection of a dam 175 ft. in height, which will provide 150,000 acre-ft. of live storage.

The interests behind the Cacapon Power Co. are the same as those behind the Cheat River development. This Cacapon storage will be of great value in taking care of the peak loads on that system and in providing power during periods of minimum rainfall. This is one of the free storage sites relied upon by Major Max Tyler in his plan for the development of Great Falls on the Potomac.

Fire Protection Association Meets in Chicago

Reports of committees on automatic sprinklers, fire pumps, private fire supplies from public mains, hydrants and valves, and a tentative building exits code, were matters of engineering interest at the twenty-seventh annual meeting of the National Fire Protection Association, held in Chicago May 8, 9 and 10. Also, changes in former automatic sprinkler regulations were submitted, together with a section defining outside protection requirements as to layout, size, kind and location of pipes and hydrants, monitors, valves, blow-offs and tests. Tentative regulations were submitted for fire department hose connections for sprinkler and standpipe systems and for steam turbines driving centrifugal fire pumps. The report of the committee on private fire supplies for public mains was largely an analysis of the basis for charges for public service connections.

Much criticism was given from the floor against the committee on safety to life for going into the question only from the standpoint of getting people out of burning structures rather than in paying attention to the structure itself. Slide escapes were decidedly ruled out of the 50-page tentative building exits code submitted.

Engineering Societies

Calendar

Annual Meetings

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 20-23.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29.

The Brooklyn Engineers' Club, at its meeting May 10, elected the following as officers for the ensuing year: Linford S. Stiles, president; Calvin C. Hough, vice-president; Joseph Strachan, secretary; William H. Wharton, treasurer; Philip P. Farley, F. E. Cudworth, J. B. French, W. J. Shea, and Peter B. Bie, directors.

The Providence Engineering Society at its May 15 meeting was addressed by Robert Ridgway, chief engineer of the New York Transit Commission, on features of rapid-transit construction in New York City.

The St. Louis Railway Club at its annual meeting elected the following officers; president, Edward Clemens; vice-presidents, K. B. Hannigan, R. C. White and W. E. Williams; secretary and treasurer, B. W. Frauenthal.

The New Jersey State Highway Department will employ convicts from the state prison at Trenton and the Rahway reformatory on the roads in the vicinity of the two institutions.

American Association of Engineers' Annual Convention, Norfolk, Va., May 7-9.

Personal Notes

RUDOLPH P. MILLER has been reappointed representative of the Federated American Engineering Societies on the National Board for Jurisdictional Awards for the term of office beginning next August.

R. W. EDWARDS, former general superintendent of transportations of the Missouri, Kansas & Texas R.R., has been appointed district manager of the car service division of the American Railway Association at Toledo, Ohio.

W. E. COPELAND is now structural steel designer for Stone & Webster, Inc., Boston, Mass. Until recently he was engaged in the same work with McClintic-Marshall Co., of Pittsburgh.

G. M. RAPP, former structural draftsman of the Bethlehem Steel Bridge Corp., is now with the Delaware River Bridge Joint Commission, engaged as a junior engineer in the design department.

FRANK F. HEALEY has been employed by the Chamber of Commerce of the United States as consulting engineer to its building committee in the design and construction of the new home for the chamber in Washington, D. C. Mr. Healey was recently with L. E. Myers Co., Chicago, Ill.

O. W. GATCHELL has been made office engineer in the Carolina headquarters for the Phoenix Utility Co., contractors. Mr. Gatchell formerly was assistant to Frank T. Miller, consulting civil engineer of Greensboro, N. C.

JAMES D. ANDREW has recently become associated with the engineering, construction and management firm of Stevens & Wood, Inc., New York City. Mr. Andrew has been placed in charge of the Youngstown, Ohio, office.

S. H. SHOWELL has joined the staff of the Lakewood Engineering Co., manufacturer of construction equipment, as sales engineer. He was formerly superintendent of road construction with Smith & Quynn of Parkersburg, W. Va.

R. M. STROHL, until recently engineer with the Carolina Engineering Co., has become a partner in the general contracting firm of Clague & Strohl, Bowling Green, Ohio.

R. F. KELLOGG, for the past four years resident engineer on highway construction with the Bureau of Highways of Idaho, has recently joined the engineering staff of the State Road Commission of West Virginia. He is employed on the construction of the Northwestern Turnpike and is stationed at Gormania.

H. W. HARTMANN, until recently superintendent of construction with W. C. Meneely Co., has become the senior partner in the firm of Hartmann-Clark Bros. Co., contractors of Dwight, Ill.

ALEXANDER W. BLYTH, for the past three years connected with the Communipaw Co., New York City, as construction manager has resigned and has accepted a position as chief engineer with Louis Chevalier, Inc., contractors and builders, New York City.

HUGH PATTISON has been appointed electrical engineer of the Virginian Ry., with offices at Roanoke, Va., and will have charge of the electrification of the 135-mile division crossing the Allegheny mountains. He was formerly electrical engineer of the Illinois Central R.R. in planning the electrification of its Chicago terminal lines.

DR. PHILIP B. WOODWORTH, president of Rose Polytechnic Institute, Terre Haute, Ind., has been granted an indefinite leave of absence, at his request. For two years he has been busy with the design and construction of the new buildings, opened early in 1923 and some weeks ago he suffered injuries in an automobile accident.

JAMES G. STEESE, president, Alaska Road Commission, has been appointed in addition chairman and chief engineer of the Alaskan Engineering Commission, operating the Alaska Railroad. John C. Gotwals, chief engineer, Alaska Road Commission, has been appointed vice-chairman in charge of operations.

SAMUEL FLEISCHER, of the Fleischer Construction Co., Minneapolis, Minn., is an incorporator for the Marion Holding Co. and the Cecil Holding Co., recently incorporated under the laws of Colorado to do building construction in that state.

HERBERT FLAGG, chief engineer of the State Department of Public Works, Olympia, Wash., has been appointed a member of the advisory committee of the valuation committee of the National Association of Railway and Utilities Commissioners.

ALBERT B. BARTLETT, a graduate of the University of Missouri, lately assistant state engineer for Wyoming, has been appointed state geologist by Governor Ross.

R. V. GLENN, consulting engineer for Tarrant County, Texas, at Ft. Worth, in charge of highway construction since 1920, has resigned, his resignation to become effective May 1. Mr. Glenn was formerly connected with U. S. Bureau of Public Roads.

R. G. WEST, construction engineer formerly with James Stewart & Co. New York City, is now with Thomas M. Murray, building contractor of Houston.

E. E. SANDS and R. J. CUMMINS have formed the firm of E. E. Sands & R. J. Cummins, Mason Bldg., Houston, Texas, consulting engineers. This firm is engaged in preparing preliminary plans for dock construction at Corpus Christi. Mr. Sands was formerly city engineer of Houston and at present is president of the Texas Section, Am. Soc. C.E. Mr. Cummins is a well known construction engineer.

S. B. THAYER, SON & CO., engineers, organizers and financiers of Wilmington, Del., have moved their office to the Munsey Building, Washington, D. C. This change will not affect offices in other cities maintained by the Thayer company.

JOHN E. MCINTYRE formerly assistant resident engineer on federal-aid highway work in Shawnee County, Kansas, has accepted a position as assistant state highway engineer, Kansas Highway Commission. Mr. McIntyre is a veteran of the World War having seen service overseas with the 110th Engineers.

MAJOR F. R. SCHANCK, consulting engineer, Chicago, for the Columbia Valley Power Co., New York, is making surveys and engineering investigations preparatory to the construction of two-hydro-electric power plants, totaling 175,000 hp., on the Deschutes River, Ore.

Obituary

W. G. COMBER, Assistant Engineer attached to the office of the Chief of Engineers, U. S. Army, died en route to that city recently from Portland, Ore. Mr. Comber had traveled extensively where the Corps of Engineers was executing work, taking charge or planning dredging operations. From 1906 to 1917 he was in Panama as resident engineer in charge of dredging operations on the canal. Mr. Comber was born in England but came to this country when a young man and began engineering as an axeman with one of the Mississippi River Commission's engineering parties.

REX C. STARR was found dead on May 3 in the Lake Yosemite-LeGrande Canal of the Merced (Calif.) Irrigation District. Mr. Starr was the chief engineer of the Merced Irrigation District which had just completed the canal, a member of the firm of Thebo, Starr & Anderton, construction engineers, San Francisco, and construction engineer for the San Joaquin Light & Power Corp., one of the best known construction engineers of the Pacific Coast, Mr. Starr had been connected with many of the important projects in recent years and with other members of his firm carried on an extensive business in addition to the power company and the irrigation district interests to which he gave a great deal of his personal attention. All of the circumstances concerning Mr. Starr's death are not known, but a note found with his coat and hat on the bank of the canal lead to the belief that he took his own life while suffering from a nervous breakdown.

DONALD S. BARTON, formerly general manager, Canada General Electric Light Co., Levis, Que., and consulting engineer of the Quebec Railway, Light, Heat & Power Co., died in Quebec April 23. Mr. Barton was born in India and educated in England, and came to Canada in 1900.

JAMES R. SCOTT, JR., chief engineer for the Colorado Builders Supply Co., died in Denver, Colo., May 3, aged 37 years. Some years ago Mr. Scott was the designer and in charge of the Colfax-Larimer viaduct in Denver and the Salt Lake City viaduct. He was a graduate of the University of Illinois.

CHARLES W. DRAKE, 132 West 70th St., New York City, died May 8 at the age of 72 years. He was formely connected with the Missouri, Kansas & Texas R.R. and the Denver & Rio Grande, and secretary of the Rio Grande & Western, but for the last fifteen years had been engaged in manufacturing in New York City.

CHAUNCEY M. DAVIDS, civil engineer, Denver, Colo., died recently in that city. He was a resident of Denver for more than forty years and built a part of the Denver & Rio Grande R.R. and the Colorado Midland R.R., and later took up the development of oil fields.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Performance Records Need Close Scrutiny

Best Test of Equipment is Cost of Work Over Extended Period

By D. C. Grove
Advertising Manager, Blaw-Knox Co., Pittsburgh

RECORD runs are usually the result of (1) a deliberate setting of the stage by the manufacturer or user of equipment to obtain the greatest efficiency within a specific time; or (2) a more or less accidental gathering together of ideal conditions. Neither of these cases represents a standard performance and the practice does more harm than good because it is apt to mislead not only the purchaser of machinery of a specific make but the purchaser of machinery of the particular type. In other words, misleading performance records may affect the entire trade and so do much to disabuse sales co-operation which has been so effective in promoting American business. If figures were compiled they would show that the cost of energy and brain power required for staging a run, plus the cost of clearing the way from outside interference, plus the drop in efficiency after the run, would be far in excess of any gain.

In some sections of the country, due to local conditions, remarkable speed can be made for a short period. Such speed constitutes what might be termed a record run. At the same time, conditions over which it is possible to exercise no control might prevent a repetition of the feat in another section of the country although similar equipment, same amount of labor and other factors present in the one test were on hand in the other.

Reliability of Figures

There is still another point to take into account when record runs are considered and that is: How reliable are the cost figures? It would probably be found that, in attempting to duplicate the progress, cost elements would creep in which had been either intentionally or accidentally disregarded in the first record and which would entirely change the original figures.

Experienced, practical men take record run figures with more than a grain of salt. The Blaw-Knox Co., for instance, in its Batcherplant, has an admirable machine with which to obtan record-run data. Its mechanism enables trucks or batch-boxes to be filled with premeasured aggregate just as fast as trucks and batch boxes can be run under the hoppers. This company, however, cannot control the movement of trucks and batch boxes so that any record run, based upon the operation of the Batcherplant, must reflect not only upon the efficiency of the plant itself, but upon all of the other elements which the contractor would contribute to accomplish a more than average run. On the other hand, if a contractor using the Batcherplant performed about half an average day's work in a day's time it would not be fair to reflect upon the Batcher-plant, as its mechanism will work just so long and just so fast as the operator can pull the lever.

In the same way we obtain a reaction from record performances of clamshell buckets where we often receive reports that a particular bucket has succeeded in unloading a tremendous number of cars within a certain time. Of course, this reflects favorably upon the bucket but the record itself is due as well to the good features in the crane, the ability of the operator and many other circumstances.

During last year's road building season this company received many instances of records established by Blaw-Knox turntables which helped many contractors establish record runs but they were not alone in making the record run possible. The effectiveness of a turntable, so far as truck speed is concerned, is in direct proportion to the number of trucks used on a job. It is logical that the greater number of trucks used, the more time will be saved by the turntable; therefore, the better the record made by the contractor.

These arguments on the featuring of record runs can be resolved into the one really informative and sensible factor: the *cost* of doing work over a period of time with the use of certain methods and equipment. It is only in rare instances that we find speed so absolutely necessary that cost can be disregarded in order to finish a piece of work within a certain time limit.

It has been the practice of the Blaw-Knox Co. to use in its advertising statements by users of its equipment regarding the services which such equipment has performed. In many of these so-called testimonials it has been impossible to establish a basis of comparison but the figures were presented as offered and in all instances revealed reductions in cost well worthy of note by the readers of the publications. We do not consider such advertisements to be illustrations of record runs but rather the expressions of pleased customers over the increased profits they have been able to obtain, due to the efficiency of our products. No attempt has been made in our advertising to lead the reader to believe that because John Smith saved $800 a month with a turntable, that every contractor buying a turntable will likewise save $800 per month. In this particular advertisement, it was explained that the savings accruing from the use of a turntable were directly proportional to the number of trucks used. Furthemore, such savings were so clean cut in their presentation and so independent of the operation of any other factor on the job that the reader could immediately determine whether or not his contract or his conditions were such as to justify the purchase of the equipment.

General Conference on Asphalt to Include Producers and Users

The Division of Simplified Practice of the U. S. Department of Commerce on May 7 sent out a call for attendance at a general conference for the reduction of varieties of asphalt to include producers, state highway and municipal engineers, the U. S. Bureau of Public Roads, and delegates from national engineering societies. The conference will be held at the Commerce Building, Washington, D. C., 10:30 a.m., May 28 and follows the preliminary conference in Washington, held April 24 (see *Engineering News-Record*, May 3, p. 808).

In a letter announcing the conference R. M. Hudson, of the Commerce Department, says: "It is felt that a reduction of variety in penetration limits called for will work to the advantage of both producers and consumers, and that mutual agreement in this matter can be effectively accomplished through the medium of this office. Secretary Hoover believes that action of this sort by industry is most constructive and is glad to co-operate and support such action by publishing the results in the Department of Commerce 'Elimination of Waste' reports."

To Avert "Buyers' Strike" in Construction Industry

Washington Correspondence

Over-ordering of cement which recently was made the subject of complaint by producers, is being taken up directly between the producers and contractors with good prospects that orders will be pared to actual necessities, according to information received in official circles in Washington. It appears probable therefore that there will be no conference with federal officials on this subject, as had been suggested at one time.

Evidences of a "buyers' strike" in the construction industry, as reported in newspaper dispatches from various cities where temporary withdrawal of projects has been announced on account of high costs, are being watched closely by Washington officials. While a reasonable let-up in new construction projects would be welcomed as tending to relieve pressure upon material and supply houses and upon the labor supply, there is some fear that the psychological effects may extend to other lines of industry. Conditions in the building industry have been recognized as abnormal, and in considering possible inflation of business this industry has been set in a class by itself by government economists.

A general easing of business conditions since the middle of April has been noted in Washington and it is considered by government officials that the caution now being displayed has averted the possibility of a period of inflation.

Business Notes

Clay Products Association announces that Charles A. Newhall, consulting chemist, of Seattle, Wash., has been retained as Northwest investigator for the clay products industries. Mr. Newhall has had many years of

practical experience in the manufacture, testing and use of cement and clay products as well as other construction materials. He is a graduate of the University of California and has been practising his profession in the Northwest since 1907. It is a new policy for the association to retain technically trained local investigators in the construction materials field.

ANDREW W. HOOD, superintendent since 1909 of the Elmira plant of the American Bridge Co., has been appointed acting operating manager of all plants in the company's Eastern division, with headquarters at Philadelphia.

A. C. LINBERG has joined the Chicago office of the Cement Gun Co., Inc., Allentown, Pa., as associate to J. M. Crom, district manager. Mr. Linberg was formerly general superintendent with the Fred T. Ley Co., Inc., and the Thompson-Starrett Co. His new work will relate to contracts for the Cement Gun Contracting Co., not only for gunite, but also for the construction of reservoirs, dams, levees and similar work.

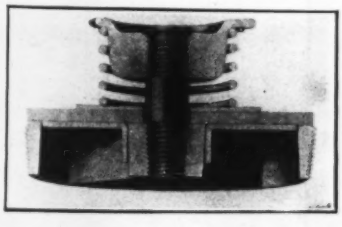
Equipment and Materials

Water Works Equipment

Equipment and materials employed in the water-works field are featured in this issue preceding the annual convention and exhibit of the American Water Works Association, to be held in Detroit, May 21-25.

Flexible Rubber in Pump Valve Increases Service

In a new type of pump valve designed by the Worthington Pump & Machinery Corp., New York, wear is reduced and watertightness secured by the use of flexible rubber for the seat instead of hard rubber in which cracks



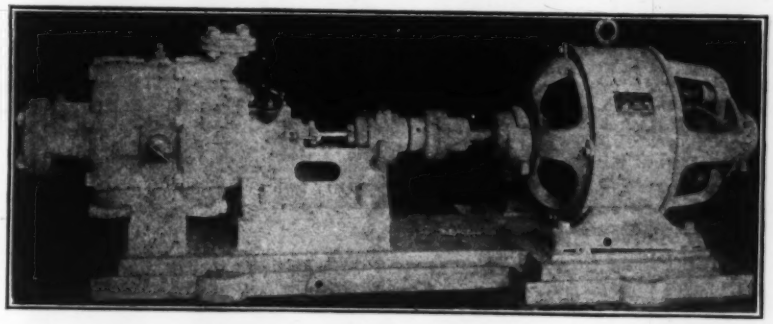
and cuts occur. Another feature of the new valve, the company points out, is the so-called bottom plate, which is, in effect, a middle seat for the rubber valve proper. The accompanying illustration shows the relation of the parts.

When the valve is closed the middle seat carries the entire load and prevents the rubber seal from cutting on the seats or ribs. The bottom plate moves up and down with the rubber and helps keep the valve in shape even when open. Thus all mechanical functions requiring strength and wear resistance are cared for by metal parts, the flexible rubber acting as a seal against leakage. Even the top of the rubber seal is protected by a thin backing plate which keeps the rubber flat and prevents the possibility of wear from contact with the spring. To assure a smooth, quiet running pump and few repairs, all moving parts are light but rigid.

Pump Designed for Small Output Against High Head

For operating requirements calling for the delivery of a small quantity of water against a relatively high head, the Pelton Water Wheel Co., San Francisco and New York, has recently bought out its type F D centrifugal pump. This pump is built either two or four-stage, the two-stage unit being recommended for heads under 110 ft., while the four-stage pumps are designed for heads as high as 220 ft. The capacity for either type at a speed of 1,750 r.p.m., ranges from 60 to 90 gal. per minute according to the head.

The casting is split vertically to permit easy access to the rotating elements. Communicating chambers from



one impeller to the next are provided within the casing itself. A special suction bearing within the suction inlet precludes the possibility of vibration in the shaft. Since this bearing is water-lubricated, it requires no attention while the pump is being operated. Proper balance is insured by the use of an equal number, respectively, of right and left-hand impellers.

Such a pump can supply either an elevated tank or a pressure tank on the ground level, and it can be arranged to start and stop automatically, so as to require very little attention. It is adapted to the following classes of service: (1) Small public utility systems, either municipal or privately owned. (Taking the average capacity of 75 gal. per minute, such a pump would supply more than 200 gallons per capita per day to a village of 500 inhabitants.) (2) Isolated industries, farms, and country places, for both ordinary service and fire protection. (3) Office buildings, industries, etc., as a booster pump where the city pressure is inadequate.

Meter Detail Improved

This year's model of water meter manufacturd by the Simplex Valve & Meter Co., Philadelphia, contains an improvement in the form of a metal dome with glass cover instead of the glass dome, as was universally used in the earlier stages of manufacture. The glass dome proved too fragile for boiler plant use.

Another feature is the frost-proof type, which is installed in all exposed situations. One recent striking accomplishment cited by the company is the furnishing of a large number of meters for use in measuring the flow in a supply pipe at a large hydroelectric company's plant, having a working pressure of about 900 lb. per square inch.

Water Meter Has New Breakable Frost Bottom

A new feature of the American water meter, manufactured by the Buffalo Meter Co., Buffalo, N. Y., is the provision of protection against frost by means of a breakable bottom of galvanized cast-iron. When the frost bottom breaks out it releases the disc chamber and the intermediate gearing, and permits all their parts to separate and move with the ice. Heretofore, it is claimed, no intermediate gearing has been designed that has parts free to separate when the meter freezes.

Another feature is that the disc chamber seat is in the breakable bottom casing and, therefore, is renewed every time the meter freezes. The flange gasket is not disturbed when the bottom casing breaks and may be used repeatedly. To increase the sensitiveness and life of the meter all submerged bearings are protected against the entrance of sand and sediment. The meter with breakable frost bottom is made in sizes of ¾ in., 1 in., and 1 in.

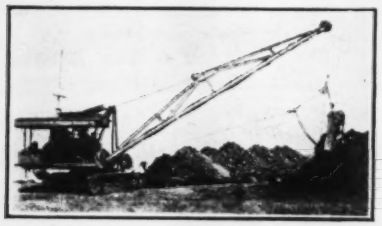
Water Lubricated, Rubber-Lined Bearings for Pump

To facilitate the operation of turbine centrifugal pumps handling water containing grit, the Thomas Pump Co., Chicago, has developed water-lubricated, rubber-lined bearings which are vulcanized into brass sleeves and grooved like the bore of a rifle. The action of the water when flowing upward in the turbine drop-pipe, it is explained, circulates through the grooves and not only serves as a lubricant but carries grit in suspension through the grooves. The bearings also offer resiliency to the revolving shaft.

Bearings of the sort described are being used in deep-well turbine pumps. The use of rubber bearings, the company states, is not new, but it is claimed that only recently have they been adapted to vertical turbine pump installations.

Trench 23½ Ft. Deep Excavated with Dragline

What is claimed to be one of the deepest trenches ever excavated with a ¾-yd. dragline was dug by a Pawling & Harnischfeger machine owned by



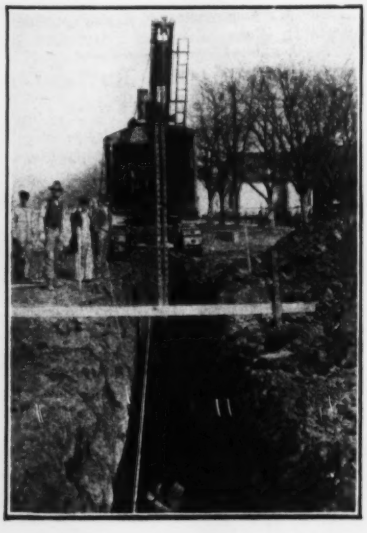
Kremer & Hog at Minneapolis. The machine, illustrated herewith, had a 38-ft. boom and dug a trench to a depth of 23 ft. 6 in., which is about 5½ ft. deeper than was heretofore considered by the manufacturer possible with this type of machine.

The trench was 5 ft. wide at the bottom and from 12 to 15 ft. wide at the top. The material was for the most part a yellow clay, with bottom material running 3 to 8 ft. of heavy blue clay. A total of 1,700 ft. of this trench was dug in thirty-two 11-hour shifts.

The machine was also used to lower sewer pipe into place. To do this the dragline bucket was replaced with a U-shaped hook. The machine was also used to backfill the earth after the pipe had been laid.

Power Shovel Hoe Digs Trenches for Pipe Lines and Sewers

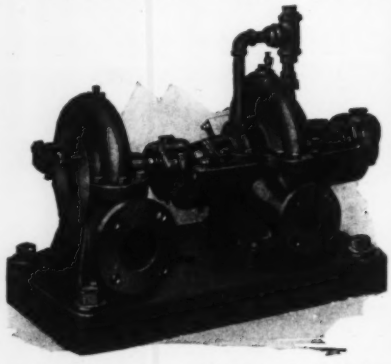
Designed especially for the excavation of trenches for water-supply pipe lines and sewers, the steam "hoe" attachment for its crawler mounted power shovel has been improved in a number of features by the Erie Steam Shovel Co., Erie, Pa. As shown in the accompanying photograph, the hoe works toward the machine, allowing the latter to ride on solid ground instead of straddling the trench, thus eliminating a cause of cave-ins. The steam hoe, its manufacturers claim, is especially valuable in digging trenches through material that is very hard but that caves in easily, such as cemented gravel and boulders.



With standard dipper handle and boom at the usual angle the equipment can dig a trench 12 ft. deep and dump material 33 ft. distant, piling the excavated material 14 ft. above grade. A longer special dipper handle is made for trenches 18 to 20 ft. deep. The machine, its manufacturer states, is capable of an output of from 200 to 300 yd. a day on trench excavation. The steam hoe is convertible to a power shovel or locomotive crane.

Turbine Pump Auxiliary Driven by Flow from Main Discharge

A small hydraulic turbine-driven centrifugal pump is a type of unit furnished recently by the Allis-Chalmers Manufacturing Co., Milwaukee, in connection with water-works pumping installations for handling the condensate out of the condenser hot-well. The spiral casing having a side opening located at the left end of the base plate is a small re-action type hydraulic



turbine, the runner of the turbine being mounted on the extended shaft of the centrifugal pump which it drives. The centrifugal pump is a standard type of horizontal split-casing, double-suction pump. The water for operating the hydraulic turbine to drive the pump is taken off from the main pump discharge pipe or from the series piping between the first and second stages of a series pump unit, and the discharge from the turbine is either piped back to the main pump suction or into the suction well.

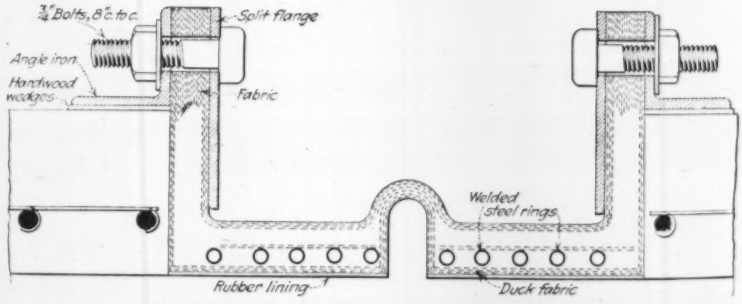
For this hydraulic turbine-driven auxiliary two advantages are claimed: first, its simplicity of operation, as it can be arranged to start automatically when the main unit is started up, and second its economy. A 50 gal. per minute, 75-ft. condensate pump, the company states would require a 7-hp. steam turbine for the drive, and figuring 70 lb. per brake horsepower for the water rate for the small steam turbine, the condensate pump would use 490 lb. of steam per hour. On the other hand, if the pump is driven by a hydraulic turbine under 140-ft. head the turbine would require 360 gal. per minute tapped off from the main pump discharge. This capacity would be pumped at the efficiency of the main pump, or over 80 per cent, and the main pump would be operated by the main turbine having a water rate of around 11 lb. per brake horsepower hour. On this basis, the condensate unit would require only 170 lb. of steam per hour for its operation.

Hydraulic turbine-driven auxiliaries, the Allis-Chalmers engineers point out, can also be used as circulating pumps and even as low-service, raw-water pumps, this type of auxiliary unit is a quite recent application of water-works service.

Flexible Rubber Joint for Concrete Pipe

To provide flexibility for changes in alignment and for expansion of reinforced-concrete pipe, Coleman Meriwether, of Core Joint Concrete Pipe Co., Inc., New York, has developed a joint of rubber and fabric reinforced with welded steel rings, as shown in the accompanying drawing. The joint may be expanded 1½ in. on one side and contracted 1 in. on the other. It is made in sizes to fit pipe ranging in diameter from 6 to 72 in. The concrete portion of the pipe is 16 ft. long and the joint 1 ft. long.

To form a flange, to which the joint is bolted at each end, 2½ x 2½ x ¼ in. angle irons, ¼ in. larger in inside diameter than the outer diameter of the pipe, are placed at each end of the pipe section and tightened with hardwood wedges closely spaced, making the angle ring concentric with the concrete pipe. The joints are bolted up with ⅞ x 3¼-in. standard machine bolt spaced approximately 8 in. on centers.



REINFORCED CONCRETE PIPE JOINT OF RUBBER AND FABRIC

This type of joint, it is claimed, is particularly adapted to subaqueous pipe-line construction or to inverted siphons or pressure pipe lines on land. Irregularities in the foundation material for expansion and contraction are taken care of by the flexible feature of the joint. For subaqueous work a number of sections of pipe can be jointed together on shore, bulkheaded at both ends, floated to place and sunk, thus causing a minimum number of joints to be made by a diver.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

April Sales of Municipal Bonds Show Gain

A gain of about $5,000,000, as compared with the previous month was shown by sales during April of long-term municipal securities, totaling about $75,000,000 as compared with about $70,000,000 in March. The April figures represent the combined output of 408 municipalities which made 540 separate issues as compared with 327 municipalities making 582 issues during March. The increase, according to the *Commercial & Financial Chronicle*, is due to the fact that there were four large issues in April. During that month blocks of $6,394,000, $4,500,000, and $3,540,000 were sold, whereas in March the largest issue placed totaled $3,029,000.

For purposes of comparison it may be noted that the April sales of municipal securities (including states, counties and districts) aggregated $137,000,000 in 1922, $88,000,000 in 1921, and $66,000,000 in 1920. The large volume of last year's output is due to the fact that New York City put out $45,000,000 4½ corporate stock and three states floated $17,000,000 in bonds.

Of the 48 representative issues listed in the table one sold at par, 45 above, and only two below par.

Watch "Engineering News-Record's" Construction Barometer

(*See "Construction News," p. 287*)

An industrial depression is a stubborn, chronic malady. Its beginning is gradual and quiet. It commences and goes on increasing for many months, unnoticed, and its cause is silently doing its fatal work while actual business is increasing by leaps and bounds. When actual depression appears, its cause has almost ceased to exist. From its nature, as well as from its deep-seated and gradual growth, industrial depression is long-lived.—From Industrial Depressions, by George H. Hull.

Large Contracts Let During Week

Among the week's announcement of contracts awarded in Construction News, pp. 287 to 302, are the following large projects:

Hospital, Charlottesville, Va., to W. P. Thurston Co., Richmond, Va., $3,000,000.

University building, Ann Arbor, Mich., to Starrett Bros., New York, N. Y., $2,000,000.

Foundation and sub-structure, Pineville, Ky., to Foundation Co. of America, Chicago, Ill., $2,000,000.

Office building, San Francisco, Calif., to G. Wagner, $1,350,000.

Railroad shops, South Portland, Me., to J. W. Gulliver Co. and others, $1,250,000.

Sewage disposal works, Jersey City, N. J., to J. L. Sigretto, Bernardsville, N. J., $1,104,401.

Musuem, New Haven, Conn., to Sperry and Treat Co., $1,000,000.

Bank and office building, Toledo, Ohio, to Spieker Constr. Co., $1,000,000.

Grading and paving, Los Angeles, Calif., to G. H. Oswald, $615,000.

REPRESENTATIVE PUBLIC BOND SALES DURING APRIL, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Massachusetts	Sewer, water, park	2,300,000	4	101.15	3.88		1923-62	Estabrook & Co., Boston
County								
Adams, Ind.	Road	14,720	4½	100.213	4.48	Apr. 15, 1923	1924-33	Old Adams County Bank, Decatur
		10,320	4½	100.14	4.49			
Boyd, Ky.	School	100,000	4½	100.00	5.00			National Bank of Commerce, St. Louis
Audobon, Ia.	Construction	50,000	5	102.60	4.76	May 1, 1923	1928-46	Ballard, Hosset & Beh, Des Moines
Steuben, N. Y.	School	225,000	4½	102.08	4.33	Jan. 1, 1923	1924-54	Sherwood & Merrifield, N. Y.
Bibb, Ga.	School	500,000	4½	100.627	4.45	May 1, 1923	1924-38	Citizens & Southern Co., Mason, Ga.
Cherokee, S. C.	School	300,000	5	100.50	4.97	April 1, 1923	1933-62	Keane, Higbie & Co., Detroit
Clay, Minn.	Ditch	70,000	4½	100.72	4.43	May 1, 1923	1925-43	Wells-Dickey Co., Minneapolis
Dodge, Wis.	Highway	965,000	5	102.03	4.73		1924-42	Illiñois Merchants Trust Co., Chicago
Gloucester, Mass.	Street	90,000	4½	102.05	4.08	May 1, 1923	1924-32	Glouster National Bank
Holmes, O.	Road	69,000	5½	100.55	5.30		1923-28	Milliken & York, Cleveland
Multnomah, Ore.	School	2,862,000	4½	100.18	4.73	Feb. & May, 1923	1926-43	Clark, Kendall Co., Portland; Halsey, Stuart & Co.; W. R. Compton Co.
Ocean, N. J.	Road	75,000	5½	100.213	5.44	June 1, 1922	1926	Security Trust Co., Camden
Owen, Ind.	Road	9,750	5	100.54	4.89	Apr. 15, 1923	1924-33	Fletcher American Co., Indianapolis
Summit, O.	Hospital	300,000	4½	100.19	4.72	April 1, 1923	1924-37	R. L. Day & Co., Boston
Wood, O.	Road	40,000	5	100.19	4.99	May 1, 1923	1924-28	Citizens Trust & Savings Bank, Columbus
Washington, Wis.	Highway	450,000	5	102.91	4.63	April 1, 1923	1925-38	Wells-Dickey Co., Minneapolis
St. Louis, Minn.	Road	1,500,000	5	101.40	4.78	Jan. 1, 1921	1931	Redmond & Co., Kissel Kinnicutt & Co., and others
Dearborn, Ind.	Road	49,200	5	100.175	4.72	April 2, 1923	1924-38	Peoples National Bank, Lawrenceburg
Aitkin, Minn.	Ditch	215,821	5½	99.50	5.27	Mar. 1, 1923	1929-43	Ballard & Co., Minneapolis
Township								
Washington, Ind.	Road	140,200	5	100.61	4.87	Mar. 15, 1923	1924-33	Fletcher-American Co. and Fletcher Savings & Trust Co.
Municipality								
Alexandria Bay, N. Y.	Street paving	29,000	5	100.361	4.98	May 1, 1923	1952	O'Brian, Potter & Co., Buffalo
Anaheim, Cal.	Sewer construction	160,000	5	101.85	4.85	April 15, 1923	1924-63	R. H. Moulton & Co., Los Angeles
Bellevue, O.	Paving	35,533	5½	102.091	5.10	Mar. 1, 1923	1924-31	First National Bank, Bellevue
Blasdell, N. Y.	Sewer	119,229	4½	101.415	4.38	April 1, 1923	1928-53	Sherwood & Merrifield, N. Y.
Bronxville, N. Y.	Street and sewer	82,750	4½	101.44	4.32	May 1, 1923	1928-39	Stacy & Braun, N. Y.
Burlington, N. C.	Street	297,000	5½	100.31	5.46	April 30, 1923	1925-41	Caldwell, Mosser & William, Chicago
E. Cleveland, O.	School	800,000	5	102.111	4.78	April 1, 1923	1924-39	Guardian Savings & Trust Co., Cleveland
Elbridge, N. Y.	Bridge	10,000	6	101.73	5.37	May 1, 1923	1924-28	Sherwood & Merrifield, N. Y.
Ellwood City, Pa.	Improvements	135,000	4½	100.64	4.22	July 1, 1922	1927-31	Frazier & Co., Philadelphia
Erie, Pa.	Grade cross. & sewer	425,000	4½	102.379	4.05	May 15, 1923	1925-53	M. M. Freeman & Co., Philadelphia
Gross Pointe Farms, Mich.	Paving	115,000	4½	101.12	4.61	June 1, 1922	1924-42	Livingston, Higbie & Co., Detroit
Henderson, N. C.	Street and sewer	200,000	5½	100.37	5.21	Mar. 1, 1923	1924-45	A. T. Bell & Co., Toledo
Lafayette, Ind.	School	125,000	5	100.29	4.90	April 15, 1923	1924-28	J. F. Wild & Co., Indianapolis, Ind.
Nashville, N. C.	Street	160,000	5	100.15	4.93	May 1, 1923	1924-28	Hibernia Securities Co., New Orleans
Ocean City, N. J.	School	493,000	5	101.419	4.90	May 1, 1923	1925-62	Ocean City Title & Trust Co.
Pittsburgh, Pa.	School	3,000,000	4.10	100.78	4.03	Mar. 1, 1923	1924-53	Union Trust Co., Pittsburgh
Saratoga, N. Y.	Highway and bridge	150,000	5	107.23	4.11	Feb. 1, 1923	1925-44	Sherwood & Merrifield, N. Y.
Scarsdale, N. Y.	Highway	50,000	4½	100.713	4.44	May 1, 1923	1928-52	National Bank of Scarsdale
Scarsdale, N. Y.	Sewage disp.	48,000	4½	102.635	4.28	May 1, 1923	1928-51	Union National Corp., N. Y.
Verona, N. J.	Building	89,000	4½	101.433	4.87	April 1, 1923	1925-53	M. M. Freeman & Co., Philadelphia
Williamstown, N. C.	Street	50,000	6	102.56	5.72	May 1, 1923	1926-43	Seasongood & Mayer, Cincinnati
Winsted, Minn.	Water	30,000	5	100.03	4.99	April 15, 1923	1943	Magraw, Kerfoot & Co., St. Paul
Buffalo, N. Y.	Water	1,700,000	4	100.278	3.98	May 1, 1923	1953	Clark, William & Co., N. Y.
Hudson, N. Y.	Street and sewer	126,000	4½	102.063	4.21	June 1, 1923	1928-35	Sherwood & Merrifield, N. Y.
West Allis, Wis.	School, street, sewer	120,000	5	103.03	4.61		1924-43	Bolger, Mosser & Willaman, Chicago
Cleveland, O.	Hospital, sewer, etc.	1,970,000	4½	100.28	4.465	Mar. 1, 1923	1924-45	Blake Bros. & Co., Boston
Kirksville, Mo.	Water	260,000	4½	98.57	4.67	May 1, 1923	1928-43	Union Trust Co., E. St. Louis; National City Co., St. Louis

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 287 to 302, are the following:

Hotel, Philadelphia, Pa., for Kugler Hotel Co., $5,000,000.

Sewers and disposal plant, Kansas City, Mo., P. Hartung, engineer, City Hall, $2,225,000.

Temple, Louisville, Ky., for Kosairs, $1,750,000.

School, Brooklyn, N. Y., for Board of Education, $1,075,000.

Excavation and concrete work for power plant, Campbellford, Ontario, Canada, for Hydro-Electric Power Commission, Toronto, $1,066,408.

Mill, Dallas, Tex., for Dallas Textile Mills Co., $1,000,000.

Big Demand for Labor

A digest of reports from 65 industrial centers received by the Employment Service of the U. S. Department of Labor for the month ended April 30 indicates that there is very little unemployment in any section of the United States. Increased demands for all classes of skilled labor, skilled mechanics and farm hands were found to be general during April. In building and construction lines the scarcity of this class of worker is affecting progress of work to a considerable degree.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 3; the next, on June 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.30	$4.50	$3.40	$3.55	$4.20	$3.85	$4.10	$3.75
Structural rivets, 100 lb.	4.40	5.00	5.25	3.75	4.25	5.15	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	4.25	+3.50	3.32½	3.45	3.85	+3.65	4.10	3.50
Steel pipe, black, 2½ to 6 in. lap, discount	49%	50%	45%	59½%	53-5%	36%	35.2@47.6%	30.15	32.76
Cast-iron pipe, 6 in. and over, ton	58.50	56.00	+63.00	60.20	60.50	69.00	60.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	2.85	2.25	2.20	2.39	2.85	2.71	2.90	2 68
Gravel, ¾ in., cu.yd.	2.25	1.90	2.25	2.00	1.75	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.90	2.00	1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	65.00	42.00	53.00	60.00	46.75	44.00	41.00	31.00	90.00
Lime, finishing, hydrated, ton.	18.60	23.50	22.50	20.00	25.50	24.00	22.00	24.00	21 00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.50	1.50	+1.50	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000.	23.50	14.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.115	.1032	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	.0893	.115	....	....	065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	1.16	1.26	—1.37	1.35	1.29	—1.39	1.24	.86	+1.38
Common Labor:									
Common labor, union, hour.	.75	.35	.....	.....	.....	.50@.55	.56¼	....	.....
Common labor, non-union, hour.	.....	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.50@.62½	+.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 81¼c.; building laborers, 75c.; minimum for pick and shovel men, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Steel-pipe, per 100 ft. net.

Montreal quotes on Douglas fir. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.00). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

With the spot coke market receding, iron and steel scrap lower and pig-iron quiet, generally, the present downward trend in steel prices becomes a natural development, not to speak of a perceptible falling off in demand. Shapes, plates and bars are now quoted at $2.50@$2.60 per 100 lb., Pittsburgh, for desirable tonnages, with the maximum at $2.65, against $2.75, recently. Premiums on plate shipments are disappearing from the market and buying in both plates and structurals is confined to smaller tonnages. It is evident that the steel price peak has been reached and passed with the tendency developing to approach nearer to a $2.50 base. Steel bars, however, advanced 25c. in San Francisco and 35c. per 100 lb. in Dallas warehouses, during the week. Cast-iron pipe also advanced $2 per ton in Dallas.

The steel ingot output for the month of April, as reported by the American Iron and Steel Institute, totaled 3,321,278 tons, compared with 3,402,007 for March and 2,444,513 during April, 1922.

Linseed oil dropped 5c. in Dallas and Denver and advanced 23c. per gal. in Montreal, since last week.

Cement prices remain firm and unchanged generally throughout the country. Although production during April increased 14 per cent as compared with the preceding month, shipments increased 24 per cent, leaving stocks on hand Apr. 30, of 11,450,000 bbl. as against 13,045,000, one month previous, according to the Geological Survey.

Lumber prices remain unchanged in the nine cities reporting weekly to *Engineering News-Record*. The Lumbermen's Bureau reports that "the general price level is about the same although there are some soft spots here and there."

Lime and brick prices have not advanced despite higher labor costs in both industries. Common brick in New York remains at $20 per M. alongside dock; higher fuel and labor costs at yards, together with recent advance from 80c., to $1 per M. in the cost of unloading brick from barges, having had no effect upon the price to the consumer.